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Nuclear Science Abstracts

Covering the Literature on Atomic Energy
in the Fields of

Biology Medicine Chemistry
Biophysics Physics Engineering
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NP-3209	A Cylindrical Cloud-Ion Chamber; Cosmic Ray Group. (Technical Report No. 5). Brown, Rau, and Reynolds.	4484
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BIOLOGY AND MEDICINE

4306
Radiation Lab., Univ. of Calif.
MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT; OCTOBER, NOVEMBER, AND DECEMBER 1950. Feb. 27, 1951. Decl. July 16, 1951. 61p. (AECD-3200; UCRL-1143)

In the tracer program, difficulties associated with the assay of astatine in biological material were solved. At^{211} was intravenously injected into rats and was injected into the anterior chamber of the eye of monkeys. Radioautographs are shown. Other experiments were conducted with carrier-free Bi^{206}, carrier-free Mn^{52}, carrier-free $Mo^{93,99}$, Np^{237}, Ta^{182} of a fair degree of specific activity, carrier-free Sc^{46}, and high specific activity Tm^{170}. Detailed data (14 tables) are given on deposition of these tracers in various body organs after intravenous or intramuscular injection and at varying time intervals after injection. Detailed data are given on experiments on the movement of Na and K in the tissues of the rat following acute radiation injury using Na^{22} and $K^{42,43}$ as tracers. Experiments are in progress on administration of a chelating agent to rats carrying a body burden of Pu^{239}, which results in increases in the urinary excretion of the radioelement. Descriptions are given of preparation of carrier-free, Pd^{103} from Rh, $Mo^{93,99}$ from Zr, W^{181} from Ta, $Ta^{177,178,182}$ from Hf. Studies on the effect of specific liver irradiation on the chromic phosphate disappearance constant in rabbits and mice are reported. The observed lowering of the disappearance constant is apparently due in part to a decrease in the efficiency of the liver phagocytes and in part to a depression of the liver blood flow. In regard to survival, either the rate at which the irradiation is given or more probably, the degree of localization in the liver and spleen seems to be important.

4307
Radiation Lab., Univ. of California
SEDOHEPTULOSE IN PHOTOSYNTHESIS BY PLANTS. A. A. Benson, J. A. Bassham, and M. Calvin. May 1, 1951. 4p. (UCRL-1268)

In a number of plants (Chlorella, Scenedesmus, Rhodospirillum rubrum, barley seedlings, soybean, alfalfa, sugar beet, spinach, and geranium) sedoheptulose was isolated as a monophosphate ester and identified by various tests. It is suggested that it performs a vital function during photosynthesis by participating in a C_2 regenerative system for the primary CO_2-acceptor rather than as a hexose precursor.

4308
Atomic Energy Project, Univ. of Rochester
THE SURFACE CHEMISTRY OF BONE; V. THE ION-BINDING PROPERTIES OF CARTILAGE. E. S. Boyd and W. F. Neuman. June 29, 1951. 18p. (UR-176)

Veal costal cartilage showed equal binding capacities for Na, Ca, and Ba. This capacity correlated closely with the sulfate content, indicating that chondroitin sulfate was responsible for the major portion of the binding. Phosphate was taken up from solution only by cartilage containing appreciable amounts of Ca. The binding of Ca by cartilage was shown to be an ion-exchange reaction. (auth)

4309
THE INFLUENCE OF VITAMIN B_{12} ON OXIDATION BY A MUTANT STRAIN OF ESCHERICHIA COLI. Evelyn L. Oginsky, Patricia H. Smith, Nicholas E. Tonhazy, Wayne W. Umbreit, Herman C. Lichstein, and Stanley F. Carson. J. Bact. 61, 581-90(1951) May.

The functions of vitamin B_{12} in bacterial metabolism were investigated using a mutant strain of Escherichia coli that requires methionine or vitamin B_{12} for growth. Vitamin B_{12} increased the rate of oxidation of a variety of substrates, and more so in aged than in freshly harvested suspensions, but did not influence the amount of O_2 uptake. Vitamin B_{12} may be concerned in the synthesis of porphyrins.

4310
STUDIES OF ISOLATED CELL COMPONENTS. III. A CYTOLOGICAL STUDY OF THE EFFECTS OF HEPARIN ON ISOLATED NUCLEI. Henry Stoutte Roberts and Norman G. Anderson. Exptl. Cell Research 2, 224-34(1951) June.

Isolated nuclei from rat liver in salt-sucrose medium, when treated with heparin, methylene blue, azure A, and methyl green, showed characteristic structural damages. The nuclei of leucocytes included in these preparations showed no such damage. It is concluded that heparin replaces desoxyribonucleic acid (DNA) in the nucleo-histone of the nucleus, causing the structural damages observed, and releasing DNA in the form of a soluble viscous protein-containing complex.

RADIATION EFFECTS

4311
[Argonne National Lab.]
TRITIUM-INDUCED EFFECTS IN PARAMECIUM AURELIA. E. L. Powers and Deborah Shefner. May 1951. 13p. (AECU-1485; UAC-403)

Isolated specimens of Paramecium aurelia, kept during 2 days in culture fluid containing 1 to 100 mc of T per ml, calculated to emit a radiation dosage of 630 to 64,450 rep/day, divided 6 to 8 times during that period. No effects were observed in the animals, washed after exposure, until autogamy occurred. Increasing death rates (1.9 to 98.1%) after autogamy were observed with increasing radioactivity of the medium. The observed difference in the efficiency between T and $Sr^{89,90}$ Y^{90} in inducing the effects observed is consistent with the observations of others concerning the dependence of the mutation constant upon rate of energy loss by densely ionizing particles.

4312
Oak Ridge National Lab., Y-12 Area
THE EFFECT OF X IRRADIATION ON ERYTHROGENESIS, PLASMA, AND CELL VOLUMES. Jacob Furth, G. A. Andrews, R. H. Storey, and Leon Wish. June 11, 1951. 32p. (ORNL-878)

The complex pathophysiological disturbances causing postirradiation anemia cannot be investigated by using methods commonly practiced to evaluate the red-cell picture, since simultaneous changes in plasma volume mask the magnitude of drop in erythrocyte mass. The investigations on blood tissues of dogs, rabbits, and mice after massive

irradiation reported here include determinations of red-cell and plasma volumes, reticulocyte count, number of newly formed erythrocytes (those that had taken up intravenously injected radioactive Fe), disappearance of various labeled substances from the blood and location of their retention in the body. These lead to the following conclusions: After massive irradiation, erythrogenesis ceases almost immediately and is not resumed until after 7 to 14 days. The plasma volume at first drops, and later rises. Heightened permeability of capillaries permits escape of blood cells and other substances from circulation. Phagocytic reticuloendothelial function is not markedly altered. The hypothesis is advanced that continuous leakage of erythrocytes through damaged endothelium to tissue spaces and lymph channels is a major factor in the causation of post-irradiation shock and anemia.

4313

Atomic Energy Project, Univ. of California, Los Angeles
THE EFFECT OF ROENTGEN IRRADIATION UPON PROTEIN ABSORPTION IN THE MOUSE. Leslie R. Bennett, Sarah M. Chastain, Arthur B. Decker, and James F. Mead. May 31, 1951. 13p. (UCLA-137)

The rate of protein absorption was measured in normal mice with I^{131}-labeled human serum albumin and was compared with absorption in mice exposed to 600 r of whole-body x radiation. No change in the absorption rate after exposure was observed, although a change in tone and motility of the gastrointestinal tract was noted.

4314

Radiation Lab., Univ. of California
THE MOVEMENT OF SODIUM AND POTASSIUM IN THE TISSUES OF THE RAT FOLLOWING ACUTE RADIATION INJURY USING Na^{22} AND $K^{42,43}$ AS TRACERS. John Z. Bowers and Kenneth G. Scott. Jan. 1951. 20p. (UCRL-1101)

The purpose of the experiments was to determine alterations in Na and K content of various organs and tissues, and to check Na and K defecation and excretion at various time intervals after total-body irradiation. Two μc of N^{22} with a half life of 2.6 hr, and 50 to 175 rep of K^{42} or K^{43} were injected subcutaneously. Radiations of LD_{50} and LD_{100} were used. Acute radiation injury is characterized by heavy and early losses of K from sensitive tissues (lymph nodes, small and large intestine, stomach, spleen) (irreversible injury), and less pronounced losses from other tissues (gonads, kidney, heart, lung, liver, brain, skin, skeleton, muscle, eyes) (reversible injuries). In sensitive tissues, there is an early loss of Na, but subsequently a penetration of Na into damaged cells, as indicated by an expansion of Na space. There are no characteristic or significant changes in the H_2O content of the various organs demonstrated in these experiments. (6 tables, 2 charts)

4315

DEVELOPMENT OF THYROID NEOPLASMS IN THE RAT FOLLOWING A SINGLE INJECTION OF RADIOACTIVE IODINE. R. C. Goldberg and I. L. Chaikoff. Proc. Soc. Expti. Biol. Med. 76, 563-6(1951) Mar.

Examination of 10 rats sacrificed 18 months after a single injection of 400 μc of radioactive I revealed the following changes in the thyroid gland: (1) Hürthle-like elements (previously reported by the authors in thyroids of rats sacrificed 8 months after a single I^{131} injection) were evident in the parenchyma of all glands. (2) Multiple adenomata, apparently benign in nature, were evident in the parenchyma of all glands. (2) Multiple adenomata, apparently benign in nature, were found in the thyroids of 2 rats. (3) Two types of anaplastic, nonencapsulated neoplasms, one of which was invading adjacent thyroid tissue, were also found in the thyroids of these 2 rats. (auth)

4316

EFFECT OF IMMATURITY, HYPOPHYSECTOMY, AND ADRENALECTOMY UPON CHANGES IN BLOOD PLASMA OF RAT DURING ACUTE RADIATION SYNDROME. Henry I. Kohn. Am. J. Physiol. 165, 43-56(1951) Apr. 1.

Following whole-body irradiation of the immature rat, the pattern of change in the plasma was like that in the mature animal, but the LD_{50} was about 200 r less and diarrhea appeared sooner. The effect of hypophysectomy upon the radiation reaction depended upon the age at which operation had occurred. In the adrenalectomized mature animal, the glucose and NPN reactions to irradiation were greatly diminished, the chloride reaction was modified, and the cholesterol, protein, and A/G reactions were unchanged or somewhat enhanced. Irradiation of the head and neck alone led to no changes in the plasma. Whatever role the pituitary or thyroid glands played was therefore an indirect one. Some conclusions are drawn about the role of the pituitary-adrenal system.

4317

THE EFFECT OF IONIZING RADIATIONS ON THE BROAD BEAN ROOT. PART VIII. L. H. Gray and M. E. Scholes. Brit. J. Radiology 24, 285-91(1951) May.

After exposures lasting a few min to doses of γ radiation up to 250 r, x radiation up to 140 r, and of α radiation up to 36 rep, the rate of growth of roots of Vicia faba falls to a minimum and then returns to normal. The γ- and x-ray growth inhibition is dependent on the duration of exposure. The α-ray inhibition is independent of exposure times between 10 min and 24 hr. The minimum value of the growth rate relative to control roots, which occurs at about the 6th day after irradiation, is exponentially related to dose for α radiation. It is also exponential for γ radiation delivered in 12 or 24 hr and tends to exponential for long-duration exposures to x radiation. The relation is sigmoid for both γ and x radiation at higher dose rates. The relative biological efficiency of α radiation compared with x radiation varies from about 4.5 to 12.5, according to the dose level and duration of exposure at which the radiations are compared. Histological changes seen in roots from 2 to 10 days after exposure to 140 r of x rays have been examined in detail. It is concluded that chromosome structural damage constitutes a major factor leading to growth inhibition by all three radiations. (auth)

4318

THE EFFECT OF IONIZING RADIATIONS ON THE BROAD BEAN ROOT. VIII (continued). L. H. Gray and M. E. Scholes. Brit. J. Radiology 24, 348-52(1951) June.

Two appendices to the previous articles appear. Appendix I gives a detailed description of the germination and culture of the Vicia faba used in the experiments, the method used to measure roots with minimum handling, and the procedure for irradiation by α particles. Appendix II includes an explanation of how the number of cells per unit volume of tissue of a particular region can be estimated, the method of estimating τ (duration of mitosis) and t (means intermitotic time at any point in the root), and a definition of resting nucleus, prophase, metaphase, and telophase. 20 references.

4319

EFFECTS OF IRRADIATION ON EMBRYONIC DEVELOPMENT. I. X-RAYS ON THE 10TH DAY OF GESTATION IN THE RAT. James G. Wilson and John W. Karr. Am. J. Anat. 88, 1-34(1951) Jan.

Doses of 50, 100, 200, or 400 r were given at a single exposure to intrauterine rat embryos the 10th day of gestation, with shielding of the mother animal as well as of the remaining portions of the uterus. Four types of biological effects resulted: general retardation of growth, localized

retardation of growth, aberrant growth or malformation, and embryonic death. Exposure to 400 r always caused embryonic death within 24 hr. Malformations of brain, urinary organs, liver, limbs, and inversion of aortic arches occurred after exposure to 100 or 200 r. Improvement or recovery by later accelerated mitotic rate can occur. Malformation of eyes was prevalent and complete regression may occur. 29 figures.

4320

THE EFFECT OF X-RADIATION ON THE BIOSYNTHESIS OF HEMOGLOBIN. Jonas E. Richmond, Kurt I. Altman, and Kurt Salomon. J. Biol. Chem. 190, 817-25(1951) June.

Hemoglobin synthesis was studied in bone marrow and spleen homogenates of rabbits exposed to 800 r of x radiation at a rate of 26 to 27 r/min with C^{14} labeling of specific precursors for hemin and globin. Hemin and globin synthesis are differently affected by radiation, both evidently going on at different rates. A new term, W, as an expression of the hemin- and globin-forming capacity of the organ systems is introduced and its value calculated for bone marrow and spleen homogenates.

4321

THE FREQUENCY OF X-RAY INDUCED CHROMOSOME ABERRATIONS IN TRADESCANTIA AS MODIFIED BY NEAR INFRARED RADIATION. Henry T. Yost, Jr. Genetics 36, 176-84(1951) Mar.

From the data presented on the effects of infrared radiations when used as supplementary treatments with x radiation, the following conclusions have been made: (1) pretreatment and posttreatment with infrared radiations increase the frequency of chromosome aberrations induced by x radiation; (2) the posttreatment may be delayed 93 to 96 hr after x radiation with no decrease in the effectiveness of the infrared radiations; (3) the type of aberration induced is dependent upon the time at which the x radiation is administered, and is independent of the time of infrared radiation and the time of recombination. The various hypotheses which have been advanced to explain the effect of infrared treatment are discussed. The potential break hypothesis is supported by this data. (auth)

4322

INHIBITION OF CITRIC ACID SYNTHESIS IN VIVO BY X-IRRADIATION. Kenneth P. DuBois, Kenneth W. Cochran, and John Doull. Proc. Soc. Exptl. Biol. Med. 76, 422-7(1951) Mar.

The technic of Potter (Proc. Soc. Exptl. Biol. Med. 76, 41(1951)) for measuring the effects of toxic agents on citrate accumulation vivo was applied to studies on x irradiation. Lethal doses of x ray (800 r) markedly inhibited citrate accumulation in spleen, thymus, ileum, pancreas, and testes of fluoroacetate-treated rats but exerted no significant effect on brain and heart. Sublethal doses of x ray markedly inhibited citrate accumulation in spleen and thymus. The extent of inhibition was dependent upon the dose of x ray and was reversible after sublethal doses and irreversible when lethal doses were given. Accumulation of citrate occurred in the livers of irradiated rats following fluoroacetate treatment in contrast to the inability of livers of normal male rats to accumulate citrate following fluoroacetate treatment. (auth)

4323

IRRADIATED HUMAN PLASMA AND PHAGOCYTOSIS. Jirair N. Sarian. Am. J. Roentgenol. Radium Therapy 65, 940-6(1951) June. (See also NSA 5-1741)

In an attempt to understand the mechanism of the effects of roentgen rays on inflammations, the author briefly reviews the general theories and then describes his own experimental findings. Small doses of roentgen rays, 15 to 100 r, cause a significant rise in the opsonic indices of normal human blood. The injurious effect of 30 r on leucocytes, although small enough to fall within the range of experimental error, is yet demonstrable functionally. Irradiating plasma previously separated from normal human blood enhanced phagocytosis to a degree slightly less than that attained by using plasma derived from whole blood irradiated with the same dose. Comparison as to phagocytosis of Escherichia coli and Staphylococcus aureus indicates that irradiation either produces, or more probably activates, the specific opsonins of the normal plasma. Thus convalescent or immune sera could be used (both therapeutically and prophylactically) more advantageously by irradiating them with optimal doses of roentgen rays. Such irradiated specific sera could be of particular value in the control of certain virus diseases, for example, neurotropic poliomyelitis. 55 references. (auth)

4324

NEUTRON CATARACTS. Arlington C. Krause and James O. Bond. Am. J. Opthalmol. 34, 25-35(1951) Jan.

This paper reviews the clinical and experimental investigations of roentgen and neutron radiation cataracts. The following main points are presented: Both these forms of radiant energy primarily damage the anterior epithelial cells of the lens cortex, which in turn produces abnormal fibers leading to opacities in the subcapsular regions of the cortices. Neutrons produce more damage per unit of absorbed energy than roentgen rays. This probably produces a shorter latent period. The oxidation of sulfhydryl groups on the enzymes of normal lens metabolism is presented as a possible mechanism for the biologic effect on the lens structure. (auth)

4325

Naval Radiological Defense Lab.

PLASMA PROTEINS AND PLASMA VOLUMES IN RATS FOLLOWING TOTAL BODY X-IRRADIATION (Technical Objective AW-6). Helen Supplee, James D. Hauschildt, and Cecil Entenman. May 17, 1951. 21p. (AD-318(B))

The effects of alterations in plasma volume on the plasma protein concentration after x irradiation were studied. Simultaneous measurements were made of plasma protein concentrations, plasma volumes, and total blood volume in rats for as long as 20 days after exposure to 400, 600, and 750 r total-body x radiation. In rats that received 750 r, plasma volumes decreased to values 20% below the control by the 3rd day; no significant decrease occurred in animals exposed to 400 or 600 r. Beginning with the 4th day after all exposures, an increase in the plasma volume was apparent and persisted throughout the experimental period. Plasma protein concentration was depressed by the 3rd or 4th day in all groups although the decrease was not statistically significant after exposure to 400 r. Recovery was incomplete even after the 20th post irradiation day. Comparison with starved control animals indicated that the initial loss of plasma protein after irradiation could be attributed only partially to impaired food intake. (2 tables, 4 charts)

4326

RELATION OF CLEARANCE AND DISTRIBUTION OF INJECTED GLUTATHIONE TO PROTECTION AGAINST RADIATION INJURY. E. P. Cronkite, W. H. Chapman, and George Brecher. Proc. Soc. Exptl. Biol. Med. 76, 456-9 (1951) Mar.

It has been demonstrated by experiment that: (1) The clearance of intravenously injected reduced glutathione from the blood of dogs is rapid (<30 min). (2) The disappearance of subcutaneously injected glutathione from the body of the mouse is much slower (>3 hr). (3) The distribution of injected reduced glutathione is not uniform throughout the body.

Of the organs studied it concentrates to a considerable extent in the liver, spleen, and kidneys. (4) These experiments suggest that concentration of glutathione at sites vital for survival may be the prime factor in glutathione protection of the irradiated mammal. (auth)

4327

STUDIES ON THE EFFECT OF RADIOACTIVE PHOSPHORUS ON THE BIOCHEMICAL OXIDATION OF SEWAGE. W. N. Grune and Rolf Eliassen. Sewage and Ind. Wastes 23, 141-54(1951) Feb.

On the basis of the investigations reported in this paper, the following conclusions may be drawn: It has been successfully demonstrated that ordinary tests of sanitary engineering significance may be carried out under radioactive conditions when the proper precautions and safety measures are observed. Radioactive phosphorus (P^{32}) when present in concentrations at or below 10 mc/liter exerts no significant effect on the following parameters in the first stage of the biochemical oxidation of sewage: (a) The reaction-velocity constant of biochemical oxidation, k. (b) The ultimate first-stage B.O.D. value, L. (c) The 5-day B.O.D., Yt = 5. These results give further evidence that the tentative tolerance level of 10^{-4} μc/liter is safe from the standpoint of the biochemical oxidation of organic matter in streams or other watercourses. (auth)

RADIATION HAZARDS AND PROTECTION

4328

Brookhaven National Lab.

FINAL REPORT ON EVALUATION OF PROCESS DESIGNS FOR THE BNL WASTE CONCENTRATION PLANT. B. Manowitz, R. V. Horrigan, and H. Fried. May 28, 1951. 18p. (BNL-112)

Five process designs of 600-gph evaporation units for concentrating dilute radioactive liquid wastes are discussed in reference to their probable engineering feasibility, maintenance problems, ease of operation, and relative costs. Two variations of the Knolls forced-circulation process and three variations of the BNL vapor-compression system were studied. For these systems, flowsheets are presented which include complete heat, material, energy, and activity balances. The single-effect Knolls process and the simplified BNL vapor-compression process, were chosen for detailed cost analysis. Results of the cost analyses are tabulated and arranged for ready cost comparison between the two systems. (auth)

4329

Hanford Works

THE GROSS RETENTION AND METABOLISM OF TRITIUM OXIDE IN THE MOUSE. R. C. Thompson. Jan. 23, 1951. 13p. (HW-20092)

For evaluation of radiation hazard in handling of tritium, 0.5 ml of a 0.86% saline solution, containing 190 μc tritium per ml, was injected into mice intraperitoneally daily for 13 days. Tritium was determined in body water and in the ground combusted remains of the dried carcass. The initial biological half life for tritium oxide in body water was about 1.1 days; for tissue-bound tritium about 3 days. Thirty-two days after the final injection 90% of the tritium in the animal was in the bound state, being lost with a biological half life of approximately 30 days.

4330

Hanford Works

DEPOSITION OF RADIOACTIVITY IN RATS DRINKING PILE EFFLUENT WATER. K. E. Herde. Jan. 24, 1951. 13p. (HW-20102)

Two groups of rats drank ad libitum only effluent nuclear reactor cooling water adjusted to activity density levels of approximately 3×10^{-4} and 3×10^{-5} μc/ml for periods of 200 to 500 days. Growth rate of the experimental rats was not affected by the radioactivity, and no histological changes were observed. Both effluent-drinking groups showed β radiation levels significantly higher than the controls. In the group receiving the greater concentration, blood and kidneys usually had the highest activity density with an accumulation of Na^{24} and P^{32} approximating 2×10^{-3} μc/g. This study suggests that the hazard to mammals drinking Columbia River water containing greatly diluted effluent is negligible if the diet provides all the essential elements. (auth)

4331

Hanford Works

FILTRATION OF RADIOACTIVE AEROSOLS BY GLASS FIBERS; PART TWO. APPENDICES. A. G. Blasewitz, R. V. Carlisle, B. F. Judson, M. F. Katzer, E. F. Kurtz, W. C. Schmidt, and B. Weidenbaum. Apr. 16, 1951. 120p. (HW-20847)

This report has been published in two volumes. Part one (HW-20847) contains the text of the report and describes the program which led to the design of highly efficient, glass fiber filters to be used in the filtration of radioactive aerosols. This volume (Part two) is composed of five appendixes each of which pertains to a separate phase of the program. Four of the appendixes contain experimental data presented in graphical form. The remaining appendix consists of a series of nomographs summarizing the permeability and efficiency characteristics of three types of glass fibers. (auth)

4332

Kellex Corp.

SUMMARY PROGRESS REPORT; APRIL 1951; DEVELOPMENT OF LABORATORY WASTE DISPOSAL UNIT; JOB 24-A. May 15, 1951. 9p. (KLX-1345)

Tables show results of column tests with individual radioisotopes such as Cs^{137}, $C^{14}O_3$, Sb^{125}, S^{35}, Sr^{90}, Co^{60}, Ce^{144}, and Ru^{106} or mixed radioisotopes; mixtures of resins in beds and pretreatment of beds are discussed. The results of stability tests of various filter materials immersed in different organic liquids are shown (to be used in the cartridge of the prototype unit).

4333

Illinois Univ. Engineering Experiment Station

BIBLIOGRAPHY ON AEROSOLS. Richard A. Strehlow. Feb. 28, 1951. 218p. (SO-1003)

A bibliography is given of a large number (approximately 1900) of literature references dealing with aerosols and related systems, on properties, preparation and formation, coagulation, determination, collection, pollution, and meteorology.

4334

FUNDAMENTALS OF RADIOLOGICAL DEFENSE. Department of the Navy, Bureau of Naval Personnel, NavPers 10870, 1950. 88p.

Fundamentals of atomic structure, radiation, nuclear physics and reactors, explosion phenomena, physiological aspects of an atomic explosion, radiation detection, and decontamination are presented in a manual designed as a textbook for midshipmen. The place of atomic energy activities in the armed forces organization is diagrammed, and a glossary and short bibliography are included.

4335

PERFORMANCE OF WET CELL WASHERS FOR AEROSOLS. Melvin W. First, Ralph Moschella, Leslie Silverman, and Edward Berly. Ind. Eng. Chem. 43, 1363-70(1951) June.

The range of usefulness of wetted beds of coarse glass fibers for air and gas cleaning service has been evaluated with various aerosols under variations of air velocity, cell-fiber diameter, and density of cell packing. Coarse glass fiber beds are ineffective for the removal of fine, in-

soluble particles from an air stream, and efficiency is not significantly improved by wet operation. Decreasing fiber size results in increasing efficiency, but mechanical features limit the use of fine fibers (<100 μ) to dry operation. Resistance increases with bed depth, wetting, face velocity, and fiber packing density and decreases with larger fiber diameters over the range tested. Wet cell washers give high efficiency with aerosols containing soluble acid mists and gases with low vapor pressures. The large wetted area represented by the fiber surface of even large diameter fiber packs presents a favorable situation for gas absorption. The most effective use of wet washer cells for air cleaning service may lie in this direction. 21 references. 5 tables. (auth)

4336

Industrial Radiology Lab., National Research Council of Canada

X-RAY PROTECTION COEFFICIENT OF PLATE GLASS. C. Garrett. Dec. 1949. 11p. (NRC-1975)

The protection coefficient of armor-plate glass for direct and scattered x-ray beams in the energy region 60 to 250 kv was measured experimentally as the ratio of the thickness of Pb to the thickness of glass which will absorb x rays to the same extent. It was found to be 0.01. This is below required protection and armor-plate glass should not be used as a protective material in x-ray installations.

RADIATION SICKNESS

4337

Oak Ridge National Lab.

EFFECT OF IMMATURITY, HYPOPHYSECTOMY AND ADRENALECTOMY UPON THE CHANGES IN THE BLOOD PLASMA DURING THE ACUTE RADIATION SYNDROME IN THE RAT. Henry I. Kohn, Nancy Swingley, W. J. Robertson, and Marian Kirslis. June 7, 1951. 32p. (ORNL-656)

Changes that occur, during the 10 to 14 days following total-body x irradiation of the rat, in the plasma levels of glucose, nonprotein nitrogen (NPN), phosphorus, total protein, albumin/globulin ratio (A/G), chloride, and cholesterol were reported previously (Am. J. Physiol. 165, 43-56(1951)). The effect of immaturity, hypophysectomy, or adrenalectomy on the pattern of these plasma changes has now been investigated using the same experimental conditions. Following irradiation of the immature animal (aged 35 to 40 days) the pattern of change in the plasma was like that in the mature animal (aged 90 days plus), but the LD_{50} was about 200 r less and diarrhea appeared sooner. Hypophysectomy in the immature animal prevented the chloride reaction. In the mature animal, it modified the cholesterol reaction. In both, it greatly reduced the glucose and NPN reactions. It had no effect on the protein and A/G reactions in either type. A striking difference due to age also was seen in the unirradiated hypophysectomized ainmals; in the mature group, fasting had no effect on the level of NPN. Following adrenalectomy in the mature animal, the glucose and NPN reactions to irradiation were greatly diminished, the chloride reaction was modified, and the cholesterol, protein, and A/G reactions were unchanged or somewhat enhanced. A system is proposed in which radiation effects are classified as primary or secondary, depending on whether they occur within the irradiated cell or elsewhere. It is suggested that the A/G reaction might be an indication of a primary injury, whereas the other reactions were more likely to be indications of secondary effects.

4338

BENEFICIAL EFFECTS OF VITAMIN B_{12} AND FOLIC ACID ON RECOVERY FROM INTERNAL RADIATION BY P^{32}. W. E. Cornatzer, Camillo Artom, George T. Harrell, Jr., and David Cayer. Proc. Soc. Exptl. Biol. Med. 76, 552-4 (1951) Mar.

The addition of generous amounts of folic acid, or folic acid and vitamin B_{12}, to experimental diets had no significant effect on the survival of mice injected with a dose of P^{32} in the higher range of the LD_{50} (21st day). On the other hand, when sulfasuxidine was added to the diet and the mice were injected with a dose of P^{32} slightly below the LD_{50} (21st day), the administration of vitamin B_{12} and folic acid increased significantly the time of 50% deaths, the average time of survival, and the percentage of survivors at both the 21st and the 56th day. (auth)

4339

INHIBITION BY RUTIN OF CAPILLARY INJURY BY ALPHA-RADIATION IN RATS. John Q. Griffith and James F. Couch. Blood 6, 552-4(1951) June.

A convenient laboratory method is given for determining the amount of protection of capillary integrity afforded by rutin against α radiation. Twenty milligrams of rutin given by pellet and 25 mg in solution gave good protection against up to 200 μc (given as radon ointment) of α radiation.

4340

THE PRESSOR AMINES IN THE ADRENAL MEDULLA AFTER IRRADIATION. C. T. Anderson, H. Blaschko, J. H. Burn, and R. H. Mole. Brit. J. Pharmacol. 6, 342-50 (1951) June.

Pyridoxine hydrochloride seems to protect against radiation sickness and to reduce mortality of mice given total-body x irradiation. The relation of pyridoxine and the enzyme dopa-decarboxylase to the formation of pressor amines (noradrenaline and adrenaline) has been investigated. Beginning 48 hr after lethal total x irradiation the content of pressor amines in the adrenal gland was progressively reduced. Dopa-decarboxylase activity in the liver, reduced after irradiation to some extent, was restored by adding pyridoxine to the diet; this did not influence the fall in pressor amines. Effect of insulin injection was investigated. Hypertrophy of adrenal glands following irradiation was observed.

RADIOTHERAPY

4341

CARCINOMA OF THE HYPOPHARYNX. Folke Jacobsson. Acta Radiol. 35, 1-21(1951) Jan.

An analysis is made of 322 cases of hypopharyngeal carcinoma treated at Radium-hemmet, 1939 to 1947. The present five-year cure rate is about 14%. The present method of roentgen treatment, with beam direction through fluoroscopy, is described. The influence of the tumor dose on the treatment, results, and the various complications after the treatment are discussed. (auth)

4342

DOSAGE FROM RADIOISOTOPES UNIFORMLY DISTRIBUTED WITHIN A SPHERE. T. H. Oddie. Brit. J. Radiology 24, 333-6(1951) June.

Formulas are developed for a geometric factor to allow for variations of dosage rate at points in tissue both inside and outside a sphere containing a uniformly distributed radioactive material. Values of this factor are tabulated. The results are applied to find the order of variations of dosage rate that are to be expected with a spotty distribution of I^{131} in a thyroid gland. It is shown that the dosage rate may quite easily change by a factor of more than 100 in different parts of the tissue mass. (auth)

4343
AN INTEGRATING MACHINE FOR ESTIMATING THE DOSAGE RATE OF SCATTERED X RAYS. D. K. Bewley. Brit. J. Radiology 24, 213-14(1951) Apr.

A mechanical integrator is described which evaluates doses due to scattered radiation in radiotherapy. It is based on Clarkson's method (Brit. J. Radiology 24, 265(1951)) in which the only information needed is the variation of the central axis depth doses with the surface radius of circular fields. The machine is applicable to fields of any shape. (auth)

4344
MEASUREMENT OF SKIN DOSE IN RADIUM THERAPY. Harry D. Griffith and Gerald E. Swindell. Brit. J. Radiology 24, 337-40(1951) June.

Two devices for measurement of skin dose in interstitial radium therapy are described. One employs a miniature Geiger counter and has a working range running from 5 mr/hr to 10 r/hr with a sensitive element of volume ¼ cc. The other is a fluorescence meter with a screen of area 0.5 cm^2 and a working range 5 to 120 r/hr. (auth)

4345
PHYSICAL ASPECTS OF ROTATION THERAPY WITH THE BETATRON. I. J. S. Laughlin, R. A. Harvey, L. L. Haas, J. E. Lindsay, and J. W. Beattie. Am. J. Roentgenol. Radium Therapy 65, 947-51(1951) June.

Considerations are presented on the effect of physical factors on the use of rotational therapy with roentgen rays at betatron energies. A general mathematical expression is derived which permits the accurate calculation of resultant dose distributions produced in rotating bodies. This equation is applied to the particular case of cylindrical bodies for both high-energy roentgen rays and electrons. Experimental distributions in cylindrical phantoms demonstrate its validity applied to high energy roentgen rays. These mathematical and experimental techniques constitute the basis of an investigation of dose distributions in various pertinent regions of the human body. (auth)

4346
PHYSICS IN MEDICAL RADIOLOGY. Sidney Russ, L. H. Clark, and S. R. Pelc. London, Chapman and Hall Limited, 1950. 296p.

The first part of this book contains studies of natural and artificial radioactivity, x rays, and atomic structure. The second part deals with the aspects of medical radiology and contains subject matter on photographic procedures, x-ray exposures, tracer techniques, and apparatus used in radiography and radiotherapy.

4347
THE QUESTION OF THERAPEUTIC APPLICATIONS OF FAST ELECTRONS. R. K. Kepp. Deut. med. Wochschr. 76, 639-44(1951) May 11. (In German)

The biological actions of fast electrons and the present-day attempts to apply them in therapy our outlined. Compared with x rays, the action is characterized by lower ionization densities, shorter ranges, accumulation of the dose below the surface of the irradiated object, and steep effect-vs.-dose curves. The selectivity in the action on tumors seems to be greater than that of x rays. Certain superficially located malignant tumors have been successfully treated.

4348
USES OF RADIOACTIVE GOLD COLLOID IN THERAPY AND PALLIATION OF NEOPLASTIC DISEASE. William N. Harsha. J. Kansas Med. Soc. 52, 263-6(1951) June.

A summary report on use of Au^{198} colloid in animal experiments and in treatment of metastatic neoplasm in humans states briefly some advantages, such as purity, short half life, and fairly large ionizing range, in the use of Au^{198} over other isotopes. Use of Au^{198} is likely to be important in palliation of fluid formation in neoplastic ascites and hydrothorax.

TOXICOLOGY STUDIES

4349
Atomic Energy Project, Univ. of Rochester
OBSERVATIONS ON THE METABOLISM OF A SOLUBLE SODIUM PHOSPHATE GLASS AND ITS CALCIUM SALT. R. E. Gosselin, A. Rothstein, H. Berke, G. Miller, C. Tidball, and R. C. Meir May 3, 1951. 27p. (UR-163)

As part of a study on the antidotal properties of polyphosphates in metal poisoning observations on the metabolic fate of commercial hexametaphosphate in rats and rabbits are presented. Both Na and Ca salts of the short chain product of hexametaphosphate (HMP) have a low toxicity in rats and rabbits, but the former is several times more lethal than the latter; deaths may be ascribed to the acidosis which results from hydrolysis of HMP and, under certain circumstances to an acute reduction in the plasma level of ionized Ca, which results from chelation of Ca^{++} by HMP. Five charts and 2 tables give blood serum concentrations and urinary excretions of P, as salts and as labile P, at various times after various injection amounts. Given by mouth, salts of HMP appear to be almost completely hydrolyzed in the bowel. Given parenterally, HMP is excreted in the urine partly as intact polymer (labile P) and partly as the hydrolysis product orthophosphate and no fecal excretion of labile P is demonstrable. Hydrolysis in vivo destroys 70 to 95% of a parenteral dose of HMP, but the tissue sites of this enzymatic hydrolysis have not been determined. Attempts to enhance the urinary excretion of labile P demonstrate that within limits the extent of hydrolysis can be modified by the dose, the associated cation, and the route of administration. A Ca salt of HMP, given subcutaneously, combines low toxicity with a relatively high urinary excretion of unhydrolyzed polymer.

4350
Atomic Energy Project, Univ. of Rochester
THE DEPOSITION OF FLUORIDE IN GLYCOL-ASHED BONE. David Megirian. June 6, 1951. 52p. (UR-168)

Experiments reported show that bone ash equilibrated with solutions 5×10^{-4} M in fluoride and phosphate buffered from pH 5.8 to 9.7 takes up greater amounts of fluoride at low pH, and the amounts decrease as the pH rises. It is concluded that for low concentration of fluoride, in which the solubility product for CaF_2 has not been exceeded, the hydroxyl group of the apatite has been displaced by the halide, in corroboration of previous findings by Neuman et al. (J. Biol. Chem. 187, 655(1950)). Data show that one-half the total number of hydroxyl groups of bone ash were replaced by fluoride ions: the exchange reaction, therefore, seems not limited to the surface of the apatite crystals. It is shown that fluoride does not exchange with phosphate. In experiments in which fluoride was previously fixed to the bone ash by an adsorption procedure, then dried at 100 to 110°C and equilibrated for 4 days, no desorption occurred, possibly due to changes that occurred during the drying-out process or to the fact that equilibrium was not reached. It has been demonstrated that phosphate buffer solutions at pH 7.3 containing chloride ions 10^{-1}M to 1×10^{-3}M) have not displaced hydroxyl groups from the lattice nor inhibited the uptake of fluoride from solution under these experimental conditions. In fluoride-impregnated samples equilibrated with $NaHCO_3$-CO_2 buffer the fluoride was not displaced from the solid to the liquid phase. Since chloride has a greater ionic radius and nuclear charge, it may be concluded that the formation of chlorapatite cannot be realized by an ion-exchange reaction with bone ash.

4351
Atomic Energy Project, Univ. of Rochester
STUDIES ON THE RENAL EXCRETION OF BERYLLIUM. Arthur L. Underwood, Jr. June 4, 1951. 30p. (UR-171)

Carrier-free Be^7 injected into rabbits in an insoluble form was found to have very low clearance as compared with the simultaneous inulin clearance. When citrate, a potent complexer of Be, was added to ensure that the injected Be was in a soluble form, the clearance was much greater, despite the fact that ultrafiltration studies show the soluble Be to assume an insoluble form after mixing with the blood. The addition of carrier did not markedly alter the Be clearance. The clearance ratio, i.e., Be clearance/inulin clearance, was found to vary widely enough to suggest that the two substances are not excreted by the same mechanism, and thus the possibility of tubular involvement in the excretion of Be suggests itself. An experiment using caronamide and para-aminohippuric acid failed to confirm this idea. Ultrafiltration studies show that Be exists in a nondiffusible form in both blood and urine, which again suggests tubular function as the mechanism of excretion.

4352
BERYLLIUM AND BERYLLIOSIS. H. K. Niemöller. Umschau 51, 55-6(1951) Jan. 15. (In German)

Facts are reported on the appearance and spread of Be poisonings in Germany soon after the pioneer fabrication of that metal by the firm of Siemens in Berlin and the Degussa Company in Frankfurt am Main in 1928. The author has belonged to the medical staff of the latter organization and has witnessed the various phases of the long and painful process of discovery and study of the new disease. In the United States the first officially recognized cases of Be poisoning occurred in 1943. The present status of industrial law concerning occupational hazards in the Be industry are discussed briefly.

4353
BERYLLIUM POISONING. Lars Friberg. Svenska Läkartidn., 769-72(1949). (In Swedish)

An outline of pathological features of injuries produced by Be is presented. Two main forms of diseases are observed: acute chemical pneumonias, and chronical granulomatoses of the lungs.

4354
CADMIUM POISONING. Lawrence H. Cotter and B. H. Cotter. Arch. Ind. Hyg. Occupational Med. 3, 495-504 (1951) May.

A series of five cases is presented in which workers exposed to Cd had Cd in the blood and the urine but did not present the classic clinical picture of Cd poisoning. All five workers recovered after several months, with Cd disappearing from their blood and urine. Studies of their blood chemistry indicated evidences of injury to the liver, the kidney, and the bone marrow. (auth)

4355
EXCRETION OF GALLIUM BY THE RAT AND BY MAN. E. R. King, Jesse D. Perkinson, Jr., H. D. Bruner, and Joe Gray. Science 113, 555-7(1951) May 11.

A detailed comparison is made between excretion of Ga in the rat following intravenous administration of $GaCl_3$, a rapidly ionizing salt, and the slowly ionizing complex, gallium citrate. The rats received 200 to 300 μc of Ga^{72} in 1.5 to 2 mg of stable Ga. About 73% of the Ga given as the citrate was excreted in the urine by the fourth day compared with 59% for the chloride salt. The fecal excretion of the $GaCl_3$ was about twice that of the citrate. At 96 hr the urine/feces ratio was ~8 for the chloride salt and 19.3 for the citrate complex. A second comparison is made between excretion by the rat and by man of tracer and larger intravenous doses of gallium citrate. In man the chief route of excretion is also the urinary tract. In the rat studies the effective half life at the dose level used was 8.33 hr. For the larger doses in man it was ~12.5 hr.

4356
EXCRETION OF YTTRIUM-91 IN RABBITS. Barbara Kidman, Margaret Tutt, and Janet Vaughan. Nature 167, 858(1951) May 26. (Letter to the editor)

The effect of age on excretion and retention of Y in rabbits has been demonstrated following injections of Y^{91}. The mean retention in three weanling rabbits 5 to 6 weeks old, on a medium calcium diet, killed 9 days after an injection was 0.63%/g of bone, while in three 7-months old rabbits it was 0.33% of the injected dose/g of bone. The mean excretion in the urine in weanlings was 12.0% of the injected dose, whereas in adults it was 24.0% of the injected dose. These findings confirm that the decay-curve method for estimating the excretion of Y^{90} has validity.

4357
PERIPHERAL-BLOOD AND BONE-MARROW TESTS DURING EXPERIMENTAL INTOXICATION WITH URANIUM. Aldo Masturzo. Folia Med. (Naples) 33, 643-71(1950) Nov. (In Italian)

In continuation of observations on gradual intoxication of guinea pigs and rabbits with uranium chloride (Folia Med. (Naples) 33, 535(1950)), an examination was made of the changes in the peripheral blood and the bone marrow; samples of marrow were obtained from the femur of living animals by means of a surgical operation. The alterations of the blood pointed to an anemia of a normochromic type, with a hyperchromic tendency in rare cases; the bone marrow exhibited hyperplasias, the hyperactivity extending mainly to the less mature elements. (auth)

4358
THE RELATIONSHIP OF THE CELL SURFACE TO METABOLISM. Aser Rothstein, Rebecca Meier, and Leon Hurwitz. J. Cellular Comp. Physiol. 37, 57-81(1951) Feb.

U, as uranyl ion, in low concentrations acts specifically on the metabolism of the hexoses, preventing utilization of these substrates by anaerobic or aerobic pathways. Aerobic metabolism is less sensitive to U than anaerobic. There is a time factor involved in the inhibition of glucose metabolism. If the U is added earlier than, or at the same time as, the substrate, the effect is instantaneous. If the U is added 10 min after the substrate, there is a considerable delay in the appearance of any inhibition. U in concentrations that effectively block glucose metabolism has little effect on the respiration of alcohol acetate, pyruvate and lactate, or an endogenous respiration. At considerably higher concentrations, U partially inhibits the respiration of acetate and lactate. U has no effect on glycogen degradation during starvation, nor glycogen synthesis from alcohol. U has no effect on endogenous alcoholic fermentation induced by dinitrophenol. The qualitative effects of U are discussed. A hypothesis is presented concerning the active role of the cell membrane in metabolism and the specific action of U thereon. It is suggested that the phosphorylation of sugars actually takes place on the cell membrane. (auth)

TRACER APPLICATIONS

4359
McCollum-Pratt Inst., Johns Hopkins Univ.
THE BIOSYNTHESIS OF STABLE COBALTO-PROTEINS BY PLANTS. Robert Ballentine and Dorothy G. Stephens. [nd] 30p. (AECU-1353)

The aim of this investigation was to determine whether Co forms an essential part of the enzyme system in the cell other than as a constituent of vitamin B_{12}. Methods utilizing

radioactive Co^{60} tracer for studying stably bound Co in the presence of free and ionically bound Co are presented. Data for accumulation of ionic Co during growth of Neurospora crassa, a yeast, are given. Accumulation is relatively larger in lower than in higher concentrations. As much as 40% of the Co accumulated is present in stable cobalto-protein complexes, with 57% of these soluble. Similar cobalto-proteins were found in Chlorella vulgaris and in the leaves of muskmelon and tomato. None were found in oats and barley. No Co was found in the chloroplastids. No state of Co deficiency could be induced in Neurospora, even though the amounts of Co found in the mycelium are comparable to the B_{12} concentration required by Euglena for growth.

4360

Lankenau Hospital Research Inst., Institute for Cancer Research, and Temple Univ.

METABOLISM OF NEOPLASTIC TISSUE; I. THE OXIDATION OF CARBOHYDRATE AND FATTY ACIDS IN TRANSPLANTED TUMORS. Sidney Weinhouse, Ruth H. Millington, and Charles E. Wenner. [nd] 29p. (AECU-1486)

The oxidation of C^{14}-labeled glucose, carboxyl-labeled lactic acid, and carboxyl-labeled palmitic acid was studied in slices of transplanted rat and mouse tumors by measurement of incorporation of radioactivity in the respiratory CO_2. It was found that the oxidation of these substances proceeded in tumors at rates within the range of a representative group of normal tissues. Participation of the citric acid cycle in the oxidation of glucose and palmitic acid was shown by inhibition experiments with trans-aconitate, and by the formation of radioactive citric acid as an intermediate. It was concluded that the oxidation of carbohydrate and fatty acid by intact tumor cells is qualitatively and possibly also quantitatively similar to that in normal tissues. (auth)

4361

Sloane-Kettering Inst. for Cancer Research

THE ZONE OF LOCALIZATION OF ANTIBODIES. XIII. THE IN VIVO LOCALIZATION OF ANTI-LIVER-BLOOD-VESSEL ANTIBODIES IN THE RAT. David Pressman, Beila Sherman, and Leonard Korngold. [nd] 15p. (AECU-1487)

Antisera were prepared in rabbits against rat liver blood vessels. Kidney-, liver-, and lung-localizing antibodies were present in the serum. The localization of reinjected radio-antibodies favored the organ of initial fixation. Reinjected radioiodinated normal serum proteins also returned preferentially to the organ of initial localization, but to a lower extent than shown by localizing antisera. This fractionation phenomenon was attributed to the ability of the various organs to fix selectively different proteins. Purification of antibodies in vitro was carried out by absorbing radio-iodinated antiliver serum with liver blood vessel antigen and then eluting the absorbed radioactivity at pH 11. These preparations showed increased localization in the liver and kidney while no increased localization was observed in the controls.

4362

Hanford Works

A REVIEW OF DEUTERIUM TRACER STUDIES HAVING A BEARING ON THE PROBLEM OF TRITIUM OXIDE METABOLISM. R. C. Thompson. Apr. 4, 1951. 17p. (HW-20735)

A survey of 49 publications has been made. Equilibration of administered D_2O in the body H_2O seems rapid and complete. In most compounds, lipids as well as proteins, the extent of binding seems quite large and the biological half life quite short. In the absence of direct experimental evidence, it seems quite likely that such data as are available for deuterium are equally applicable to tritium.

4363

Radiation Lab., Univ. of California

THE DEPOSITION OF CARRIER-FREE RADIO-VANADIUM IN THE RAT FOLLOWING INTRAVENOUS ADMINISTRATION. Kenneth G. Scott, Joseph G. Hamilton, and Patricia C. Wallace. May 18, 1951. 10p. (UCRL-1318)

Tracer studies in the rat have been conducted employing carrier-free radiovanadium (V^{48}). There is an initial relatively rapid excretion by way of the kidneys and digestive tract, following intramuscular administration of carrier-free pentavalent V^{48} in isotonic saline solution at pH 5 to 6. Four groups of three rats each were employed, and the groups were sacrificed at 1, 4, 15, and 64 days. At the 64-day interval approximately 10% of the V^{48} is retained in the body. Principal organs of retention at this interval are the skeleton, muscle, liver, testes, and kidney. The highest concentration per gram of wet tissue was observed in the skeleton, testes, kidney, and liver. Intragastric administration was performed on one group of three rats, and it would appear that approximately 0.5% was absorbed from the digestive tract. (auth)

4364

Radiation Lab., Univ. of California

RADIOACTIVE EGGS; II. DISTRIBUTION OF RADIOACTIVITY IN THE YOLKS. David Kritchevsky and Martha R. Kirk. June 21, 1951. 12p. (UCRL-1330)

The distribution of radioactivity in the egg yolks layed by a hen fed sodium acetate $-1-C^{14}$ has been determined. The radioactivity appears in all the fractions investigated in all the yolks. The general order of decreasing activity are: cholesterol, fatty acids, phospholipids, glycerol, protein. A procedure for the separation of the dried yolk into these fractions is described. (auth)

4365

Atomic Energy Project, Univ. of Rochester

THE SURFACE CHEMISTRY OF BONE; IV. FURTHER DATA ON RECRYSTALLIZATION. W. F. Neuman and B. J. Mulryan. June 8, 1951. 13p. (UR-172)

The interaction between powdered bone and radiophosphate buffer has been investigated. It was found that the slow incorporation of labeled phosphate by the bone mineral requires the presence of an aqueous phase. It may be concluded that this slow reaction is primarily the result of a recrystallization process rather than a simple diffusion of the phosphate ion through the crystal lattice. (auth)

4366

CONVERSION OF PLASMA PROTEIN TO TISSUE PROTEIN WITHOUT EVIDENCE OF PROTEIN BREAKDOWN. C. L. Yuile, B. G. Lamson, L. L. Miller, and G. H. Whipple. J. Exptl. Med. 93, 539-51(1951) June.

Labeled plasma proteins obtained from donor dogs, previously fed ϵ-C^{14}-dl-lysine, have been given intravenously to recipient dogs. The disappearance of labeled globulin from the plasma at a rate considerably faster than albumin has been confirmed. Evidence suggesting that the mass of protein in solution in the extravascular, extracellular fluid is approximately equal to the plasma proteins in circulation has been derived from a study of the dilution of labeled plasma protein by repeated injections of nonlabeled plasma protein. The data presented favor the view that plasma proteins are utilized in the body economy after partial catabolism within the cell area and provide no evidence of complete breakdown to the amino-acid level. (auth)

4367

THE INFLUENCE OF THE METABOLIC STATE AND OF THE MEDIUM ON CARBON DIOXIDE FIXATION BY SERRATIA MARCESCENS. Dorothy J. McLean, Nancy Hawley

Robinson, and Elizabeth F. Purdie. J. Bact. 61, 617-26 (1951) May.

CO_2 fixation by Serratia marcescens was studied using bicarbonate labeled with C^{14}. The large increase (10 times) in CO_2 fixation accompanying cell growth of this bacterium is striking. It seems that the fixed C is used for protein formation. With substrates of glycerol, glucose, and pyruvate on the average 9 N atoms are assimilated from ammonia for every C assimilated from CO_2, and with malate and citrate the ratio is 13 N per C. The latter must form some compound(s) without fixation that are formed with fixation by the former. Presence of asparagine decreases fixation to the value observed with citrate and malate.

4368

THE IN VIVO DETERMINATION OF THE BIOLOGICAL DECAY OF THYROIDAL RADIOIODINE. A. Albert. Endocrinology 48, 334-8(1951) Mar.

An in vivo apparatus for determining thyroidal I^{131} in the rat is described. The proportional rate of diminution of thyroidal I^{131} in male Wistar rats was determined by this method to be 27% per day, which corresponds to a value of 2.5 μg of l-thyroxine per day. This value is in general agreement with previous methods for the determination of the secretion rate of the rat thyroid. (auth)

4369

S^{35}-GLUTATHIONE PREPARATION FROM YEAST AND TRACER STUDIES IN CANCEROUS AND NON-CANCEROUS RATS. Gladys E. Woodward. J. Franklin Inst. 251, 557-62(1951) May.

S^{35}-labeled glutathione has been synthesized biologically by yeast grown in a medium containing S^{35} in the form of sulfate. S^{35} from the labeled glutathione administered to normal rats or to rats with Walker carcinoma No. 256 was found in both the protein and the glutathione of the tissues. The concentration of S^{35} in the sulfur of the glutathione isolated was several times greater than in the protein sulfur of the same tissue. The degree of uptake of S^{35} was very nearly equal in like tissues of the normal and of the tumor-bearing rats. The degree of uptake in tumor was about the same as in liver but considerably less than in intestinal mucosa. (auth)

4370

SURFACE ACTIVITY FOLLOWING ADMINISTRATION OF RADIOACTIVE PHOSPHORUS. Abraham Geffen, Robert Loevinger, and Bernard S. Wolf. Radiology 56, 857-68 (1951) June.

The possibility of a simple technique for differentiating benign from malignant breast tumors and determining lymph node metastases by measuring β activity after P^{32} administration in affected and in control areas was investigated. It was concluded that the method is not practicable.

4371

SYNTHESIS OF NUCLEIC ACID PURINES IN THE SEA URCHIN EMBRYO. Richard Abrams. Expti. Cell Research 2, 235-42(1951) June.

Arbacia punctulata (sea urchin) embryos were shown to utilize carboxyl-labeled acetate and glycine for synthesis of nucleic acids and protein. The specific activities of desoxypentose nucleic acid (DNA) and its purines isolated from the blastula are at least 10 times greater than the corresponding values of pentose nucleic acid (RNA). The specific activities of adenine and guanine of RNA formed from glycine-1-C^{14} are identical, whereas in DNA the specific activity of adenine is less than half that of guanine. A large part of the newly formed DNA arises from unlabeled endogenous precursor.

4372

A THEORETICAL MODEL FOR DURING EARLY EMBRYONIC GROWTH. H. T. Epstein and Jerome J. Wolken. J. Cellular Comp. Physiol. 37, 195-209(1951) Apr.

It has been shown that there are probably convective processes in both the yolk and white of the egg during incubation. A theoretical model for material transport during early embryonic growth has been established on the basis that the membrane permeabilities are the important controlling factors. The solutions to the differential equations based on this hypothesis are compared with experimental data for P^{32} transport and found to be consistent as to order of magnitude for the physical constants involved in the solution. The general solution for a spherically symmetrical three-component system is also given and is shown to contain some of the more detailed features of the experimental data. (auth)

CHEMISTRY

4373

Tennessee Eastman Corp.

THE CATALYTIC DECOMPOSITION OF HYDROGEN PEROXIDE BY IRON SALTS IN ACID SOLUTION. J. H. Pomeroy, P. F. Grieger, and J. W. Gates, Jr. Sept. 15, 1945. Decl. May 23, 1951. 97p. (AECD-3162; C-1.375.5)

A theoretical discussion of the catalytic decomposition of H_2O_2 by Fe salts precedes the experimental part. Decomposition rates of H_2O_2 in solutions containing varied concentrations of a number of ions are tabulated. A detailed interpretation of how the results of the catalytic experiments were used to find the laws of catalysis and the various significant equilibrium constants is given. The decomposition of H_2O_2 in acid solutions (pH 0.5 to 3.0) at 25°C follows quite closely the first-order reaction equation $(H_2O_2)_t = (H_2O_2)_0 \exp(-k't)$, where $(H_2O_2)_t$ is the molar concentration of peroxide at time t measured in seconds, and $(H_2O_2)_0$ is the initial concentration of the peroxide. The constant k' is defined by $k' = [(21.4 \times 10^{-4})(Fe^{+3})]/(H^+)$, where (Fe^{+3}) = the concentration of the ferric ion, and not the concentration of added ferric salt. The active concentration of the ferric ion (Fe^{+3}) in the presence of other substances with which it interacts to form catalytically inactive complex ions, such as water, chloride ion, fluoride ion, sulfate ion, malonic acid, etc., may be calculated by means of several equations which have been derived from a theory of association. The agreement of experimental results with reaction rates predicted from the equations mentioned above is generally satisfactory. The theory most consistent with experimental observations states that the decomposition proceeds by the formation of free

radical chain reactions. A tabulation has been made of the chemical reactions and the physical properties of H_2O_2 and its aqueous solutions.

4374

Radioisotope Lab., Univ. of North Carolina

THE ISOTOPE EFFECT; II. PYROLYSIS OF LITHIUM ACETATE-1-C^{14}. Arthur Roe and J. B. Finlay. [nd] 5p. (AECU-1367)

Previous investigations have revealed that an appreciable isotope effect may occur in reactions involving C^{14}. A study of the pyrolysis of Li acetate−1-C^{14} was carried out to determine whether an isotope effect did occur; no isotope effect was found. 12 references.

4375

Radioisotope Lab. and Venable Chemical Lab., Univ. of North Carolina

THE ISOTOPE EFFECT; III. THE REACTION OF ACETONE-1-C^{14} WITH ALKALINE HYPOIODITE. Arthur Roe and Edward L. Albenesius. [nd] 8p. (AECU-1489)

A small but real isotope effect was found when acetone-1-C^{14} was treated with alkaline hypoiodite; the iodoform contained more than half and the acetate less than half of the activity of the original acetone. The effect is in the opposite direction from most of the other isotope effects so far reported, the $C^{12}-C^{14}$ bond apparently being more easily broken than the $C^{12}-C^{12}$ in this case. The magnitude of the effect is of the order of 3 to 6%. (auth)

4376

Illinois Inst. of Tech.

THE HYDROGEN FLUORIDE SOLVENT SYSTEM; POLAROGRAPHIC STUDIES. Alan F. Clifford and George Balog. [nd] 3p. (AECU-1491)

Preliminary work on the polarographic determination of redox potentials in liquid hydrogen fluoride is described. Redox potentials of −0.4, −0.8, −0.9, and −1.2 v have been assigned for the systems $(C_4H_9)_3\,Sn^+$, HSO_3F, $Cu(H_2O)x^{++}$, and Hg_2F_2, respectively.

4377

Pennsylvania State Coll.

POLAROGRAPHIC BEHAVIOUR OF ORGANIC COMPOUNDS; VIII. THE SYSTEM MESO-α,α'-DIBROMOSUCCINIC ACID−FUMARIC ACID. (Report No. 3) Isadore Rosenthal and Philip J. Elving. Sept. 28, 1950. 7p. (NYO-644)

Meso-α,α'-dibromosuccinic acid, that by chemical (olefinic) reduction would form either fumaric or maleic acid, has been polarographically reduced over the pH range 2 to 9 with transelimination of the bromine atoms to form fumaric acid. In either case the reduction mechanism seems to be an unsymmetrical two-electron attack on one of the C-halogen bonds with a subsequent rearrangement of the free electron pair and the displacement of the second bromine atom.

4378

Oak Ridge National Lab. Y-12 Area

THE ISOLATION AND IDENTIFICATION OF DESOXY-5-METHYL-CYTIDYLIC ACID FROM THYMUS NUCLEIC ACID. Waldo E. Cohn. June 5, 1951. 16p. (ORNL-845)

Ion-exchange fractionation of enzymatic digests of desoxyribonucleic acid (DNA) from thymus has resulted in the isolation of a desoxynucleotide of 5-methyl-cytosine in amounts small compared to the amount of cytidylic acid present, confirming earlier reports on isolation of this base from acid digests of DNA. Unless it is assumed that cytidylic acid is partially methylated (or thymidylic acid partially aminated) during the enzymatic digestion period, the desoxyribonucleotide of 5-methyl-cytosine must be regarded as a constituent of thymus nucleic acid similar to the other nucleotides, being released upon enzymatic digestion (3 spectrographic charts).

4379

Chicago Univ. (University of Chicago)

HYDRIDES AND BOROHYDRIDES OF LIGHT WEIGHT ELEMENTS AND RELATED COMPOUNDS; PROGRESS REPORT NO. 41 FOR THE PERIOD JANUARY 1, 1951, TO MARCH 31, 1951. H. I. Schlesinger, Riley Schaeffer, L. Hohnstedt, M. Steindler, and G. Urry. [nd] 7p. (NP-3207)

Further data are tabulated on the reaction between N_2H_4 and B_2H_6 in diethyl ether at −112°C. A slight impurity causing a 4% deviation in the observed H/B ratio is still present in the samples. Great effort was directed toward the accumulation of the volatile solid "monochloride," (BCl) , as a by-product in the preparation of the BCl_4. The most important observation is that the monochloride seems to be formed when samples of the tetrachloride are allowed to stand at 0°C or at room temperature, although the most careful fractionation of the tetrachloride previously had removed all the monochloride. Experiments carried out to clarify this reaction are described. The reaction between $LiBH_4$ and $LiBF_4$ in diethyl ether is discussed further. The method for preparation of $NaAlH_4$ is still not satisfactory. It seems certain that the major difficulties that still stand in the way of a thoroughly satisfactory procedure for the preparation of $NaAlH_4$ are due to the action of alumino-hydrides on tetrahydrofurane and other ethers.

4380

THE PHASE DIAGRAM OF THE BaO-TiO_2 SYSTEM. W. O. Statton. J. Chem. Phys. 19, 33-40(1951) Jan.

A method for accurately observing phase changes at high temperatures has been developed; it employs a microfurnace and uses samples of oxide mixtures weighing less than 1 mg. The samples were observed and their temperatures measured with an optical pyrometer specially adapted for this purpose and calibrated for the furnace radiation. An electrically heated resistance strip, in general of Mo, allows melting and crystallization of the oxide mixtures at any desired speed. The samples were placed directly on the strip and could be quenched by interruption of the current flow. The binary system, BaO-TiO_2, was investigated. The existence of four compounds, $BaTi_4O_9$, $BaTi_2O_5$, $BaTiO_3$, and Ba_2TiO_4, was demonstrated by liquidus curves and x-ray diffraction. A phase change of $BaTiO_3$ below the solidus temperature was observed; all oxide mixtures with less than 80 mole % TiO_2 showed this intermediate $BaTiO_3$ phase at about 1450°C. Single crystals of $BaTi_4O_9$, $BaTi_2O_5$, and $BaTiO_3$ were grown from ternary melts of $BaCO_3$, TiO_2, and $BaCl_2$. The compound $BaTi_4O_9$ showed extensive polymorphism. Attack by molten BaO mixtures on Mo and Pt produced the compounds, $BaMoO_4$, $Ba_3Pt_2O_7$, and $Ba_4Ti_2PtO_9$. (auth)

ANALYTICAL PROCEDURES

4381

Carbide and Carbon Chemicals Div., UCC, K-25

POLAROGRAPHIC DETERMINATION OF URANIUM(VI) IN SOLUTIONS CONTAINING ORTHOPHOSPHATE. E. D. Marshall, F. S. Voss, and E. M. Baer. Mar. 31, 1950. Decl. July 16, 1951. 16p. (AECD-3207; K-585 (Rev.))

U is determined polarographically after converting the H_3PO_4 ($P_2O_5\cdot 3H_2O$) to HPO_3 ($P_2O_5\cdot H_2O$). This conversion, executed by fuming with H_2SO_4, was sufficiently complete to eliminate the interference of the H_3PO_4($P_2O_5\cdot 3H_2O$) in the polarographic determination of U. In acidic hydroxylamine hydrochloride supporting electrolyte, ferric ion does not interfere but Cu must be absent. The U(VI) current-voltage curves in noncomplexing acid media, in acid media containing H_3PO_4 ($P_2O_5\cdot 3H_2O$), and in media containing pyro- or meta-

phosphoric acid are discussed. In the concentration range 10 to 100 μg of U/ml, the 95% confidence interval for a single determination is the experimental value ±4.5 μg of U/ml.

4382

Argonne National Lab.

TWO-WAY AND THREE-WAY ELECTROCHROMATOGRAPHY, APPLIED TO QUALITATIVE SEPARATIONS. Harold H. Strain. Mar. 27, 1951. 33p. (AECU-1380; UAC-375)

Two-way and three-way electrochromatographic techniques with various solvents and with paper as the absorptive phase are discussed as sensitive and rapid methods for the resolution of mixtures of ionic substances. These methods which may be utilized with very small quantities of solutes, have been applied to the qualitative separation of cations. With suitable complex-forming solvents and with specific reagents, these two-way and three-way developments permit the rapid separation and detection of the components of mixtures. Under many conditions, as in the isolation of a weakly absorbed minor constituent and in the separation of oppositely charged ions, electrochromatographic separations may be more effective and more versatile than the usual chromatographic separations based upon flow of solvent. (auth) (see also ANL-4593)

4383

Knolls Atomic Power Lab.

AN OPTICAL METHOD FOR MEASUREMENT OF SMALL AMOUNTS OF OXYGEN IN A HELIUM ATMOSPHERE. James W. Moyer and Wm. A. Ruggles. [nd] 15p. (KAPL-519)

The method described measures O_2 concentrations in He atmosphere from much less than one to many parts per million. The thickness of an O_2 film, produced by passing a known quantity of gas over an active Na surface until all O_2 present is absorbed by the Na, is optically measured by the shift in the fringe position of a Babinet compensator.

4384

North American Aviation, Inc.

RAPID, ONE-COLOR DITHIZONE METHOD FOR SMALL AMOUNTS OF Cd IN Pb. L. Silverman. May 11, 1951. 14p. (NAA-SR-122)

The particular effect of neutron irradiation on Cd (Chem. Eng. News 28, 4254(1950)) makes determination of low concentrations of Cd in Pb desirable. A rapid, one-color dithizone method for the colorimetric determination of Cd, in the range of 0.01 to 0.3%, without prior removal of lead is developed. If lower percentages of Cd are to be found, a portion of the Pb must be removed.

4385

ANALYSIS OF URANIUM SOLUTIONS BY X-RAY FLUORESCENCE. L. S. Birks and E. J. Brooks. Anal. Chem. 23, 707-9(1951) May.

This paper is part of a series describing the application of x-ray fluorescence to the rapid quantitative analysis of various chemical systems. It was feasible to determine U in aqueous solution in concentrations as low as 0.05 g/liter. Less than 10 min were required for each analysis, including preparation of the specimen. The accuracy for a U concentration of 1 g/liter was approximately 5% of the amount present. The presence of other elements had no effect on the U analysis except for heavy elements such as Pb, and then only when the impurity concentration exceeded 10% of the U concentration. The results indicate that x-ray-fluorescence analysis is applicable to U solutions of low concentration without previous knowledge or separation of impurities present. The rapidity of the method makes it practical as an almost continuous check on the U concentration in a separation process. (auth)

4386

CONTRIBUTIONS TO THE CHEMISTRY OF THE ELEMENTS NIOBIUM AND TANTALUM. PART II. THE ANALYTICAL DETERMINATION OF NIOBIUM AND TANTALUM. Harald Schäfer and Christel Pietruck. Z. anorg. Chem. 264, 2-16 (1951) Jan. (In German)

In a new simple procedure for the determination of Nb and Ta, Nb_2O_5 and Ta_2O_5 are transformed through the action of CCl_4, into $NbCl_5$ and $TaCl_5$, which are sublimated in vacuum and weighed; after transforming the chlorides back into oxides, and weighing the latter, the Nb and Ta contents are calculated by the methods of indirect analysis. The presence of large quantities of Sn and Ti does not distort the results. (auth)

4387

DETERMINATION OF URANIUM IN SOLUTION BY X-RAY ABSORPTION. T. W. Bartlett. Anal. Chem. 23, 705-7(1951) May.

The determination of U in solution by x-ray absorption was investigated to determine its applicability to rapid, routine U determinations on a variety of solutions. With a new type of absorption cell having a solution depth of 19 mm, straight-line calibration curves indicated a sensitivity of 14 scale divisions per gram of U per liter. The absorption by 1% solutions of possible contaminating elements increased rapidly with increasing atomic number up to 42, Mo, and above 53, I. In the absence of contaminating elements, the precision, expressed as the 95% symmetric confidence interval, was ±0.05 g/liter in the concentration range up to 10 g/liter. The lower limit of detection was approximately 0.1 g/liter. Moderate concentrations of substances of low atomic number, such as sodium, ammonium, and fluoride ions, did not interfere, but chemical separation of the U was necessary when appreciable quantities of most other elements were present. (auth)

4388

DETERMINATION OF VANADIUM IN ALUMINUM WITH THE AID OF SODIUM DIETHYLDITHYOCARBAMATE. Yu. A. Chernikov and B. M. Dobkina. Zavodskaya Lab. 16, 402-5 (1950) Apr. (In Russian)

A quantitative extraction of V (>2 μg) as a carbamate by organic solvents from 0.1N to 0.2N acid solutions permits the separation of V from Al, alkali metals, and other admixtures interfering with its determination by the colorimetric method of Vinogradov (Doklady Akad. Nauk S.S.S.R. A, 249(1931)) in which phosphotungstic acid is used.

4389

MEASUREMENT OF LOW LEVEL RADIOCARBON. E. C. Anderson, J. R. Arnold, and W. F. Libby. Rev. Sci. Instruments 22, 225-30(1951) Apr.

Techniques are described for chemical purification and measurement of radiocarbon at natural levels (10^{-12} curie/g or less). The chemical cycle has the following steps: (1) conversion of the starting material to carbon dioxide, by combustion or hydrolysis, (2) precipitation as calcium carbonate, followed by evolution of the purified carbon dioxide, (3) reduction to elementary carbon with Mg turnings, and (4) extraction with HCl and water to remove Mg and Mg oxide. The over-all yield is about 85%, based on the C in the original sample. The counting is done in a screen-wall counter, 24-in. long, with an 8-in. effective counting length. The sample (about 8.5 g) is mounted uniformly in an "infinitely thick" layer, on a split cylinder which can be shifted from "sample" to "background" position. An argon-ethylene filling is used. The background of the counter (about 400 cpm, unshielded) is reduced to 4.5 cpm by the use of an 8-in. thick Fe shield and 11 anticoincidence counters, 18 in. long. The calibration of the counter on an absolute basis is described. Its efficiency

for a 20 mg/cm² layer of carbon, over a 400 cm² area, is 5.46 ± 0.03%. (auth)

4390

MODIFICATION OF SANCHIS' METHOD FOR THE DETERMINATION OF FLUORIDE IN DRINKING WATER. Johanna P. Boonstra. Rec. trav. chim. 70, 325-30(1951) Apr.

By an alteration of the Zr-alizarin ratio in the reagent the sensitivity of Sanchis method is so increased that the latter becomes suitable for a determination with the aid of a photoelectric colorimeter. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

4391

BARIUM TITANATE TWINNING AT LOW TEMPERATURES. R. G. Rhodes. Acta Cryst. 4, 105-10(1951) Mar.

The phase transitions of barium titanate ($BaTiO_3$) single crystals have been investigated by means of x rays from room temperature to −160°C. Below the second transition, at about 0°C, crystals which were single at room temperature became highly twinned. Likewise, a complicated twinning occurred below the third transition at approximately −90°C. The temperature variation of the axial parameters and of the unit-cell volume has been measured from x-ray diffraction photographs, and the symmetry and twinning arrangement of the low-temperature phases have been determined. (auth)

4392

CRYSTAL CHEMICAL STUDIES OF THE 5f-SERIES OF ELEMENTS. XIV. OXYFLUORIDES, XOF. W. H. Zachariase Acta Cryst. 4, 231-6(1951) May

The hydrolysis of LaF_3 and YF_3 has been studied, and isolated preparations of AcOF and PuOF have been examined. LaOF and YOF have been prepared in two forms, one being rhombohedral and the other tetragonal. The crystal structures of both forms have been determined and are shown to be superstructures based upon the fluorite type. PuOF is shown to have the tetragonal structure. The single investigated sample of AcOF appears to be truly cubic with the fluorite structure. (auth)

4393

THE CRYSTAL STRUCTURE OF VANADIUM TRIFLUORIDE, VF_3. K. H. Jack and V. Gutmann. Acta Cryst. 4, 246-9 (1951) May.

The unit cell of VF_3 is rhombohedral with dimensions a = 5.373 ± 0.002 A, α = 57.52 ± 0.03°. The structure places atoms in the following special positions of space group $R\bar{3}c$: 2 V atoms at 0, 0, 0; ½, ½, ½, and 6 F atoms at ±(x, ½ − x, ¼); ±(½ − x, ¼, x); (¼, x, ½ − x), with x = −0.145 ± 0.015. Direct experimental evidence shows that the structural unit is not the unimolecular rhombohedron proposed by some workers for the isomorphous FeF_3, CoF_3, RhF_3, and PdF_3. Preliminary observations indicate that CoF_3 has a bimolecular unit cell and is isostructural with VF_3. The VF_3 structure is not identical either to that of AlF_3 or to that of the ScF_3, MoF_3, and TaF_3 group, but has relationships with each of these structure types. Almost regular octahedra of F atoms, each with a V atom at its center, are joined by sharing corners only. The F atoms are not close packed, and although their arrangement approximates to a hexagonal close packing rather than to a cubic close packing, it can be derived from the latter by relatively small atomic movements and by omission of atoms from certain sites. Principal interatomic distances are V−V = 3.73; F−F = 2.74 and 2.75; V−F = 1.95A. (auth)

4394

THE CRYSTAL STRUCTURES OF MOLYBDENUM TRIFLUORIDE, MoF_3, AND TANTALUM FLUORIDE, TaF_3. V. Gutmann and K. H. Jack. Acta Cryst. 4, 244-6(1951) May.

MoF_3 and TaF_3 are isostructural with rhenium trioxide, ReO_3. The cubic unit cell, with space group Pm3m, contains one metal atom at 0, 0, 0 and three fluorine atoms at ½, 0, 0; 0, ½, 0; and 0, 0, ½. The structure consists of regular octahedra of fluorine atoms, each with a metal atom at its center, joined by sharing corners only. The structure is alternatively described as a cubic close packing of fluorine atoms in which one-quarter of the octahedral interstices are occupied by metal atoms and in which one-quarter of the fluorine atom sites remain vacant. For MoF_3, a = 3.8985 ± 0.0005, Mo−F = 1.949 and F−F = 2.757 A. For TaF_3, a = 3.9012 ± 0.0002, Ta−F = 1.951 and F−F = 2.759 A. (auth)

4395

A NEW X-RAY DIFFRACTION METHOD FOR STUDYING IMPERFECTIONS OF CRYSTAL STRUCTURE IN POLYCRYSTALLINE SPECIMENS. Alfred J. Reis, Jerome J. Slade, Jr., and Sigmond Weissmann. J. Applied Phys. 22, 665-72(1951) May.

A new double-spectrometer method for the study of polycrystalline materials is developed. From intensity data of the diffracted spots and known angular settings of the specimen, the angular range of reflection of the misaligned scattering regions in a crystallite is determined statistically. The instrument and the technique of the multiple-exposure method is described. The statistical evaluation of the data is discussed and a mathematical treatment introducing correction terms as functions of the azimuth and of the Bragg angle is presented. A commercial silicon powder specimen was investigated. The average angular range of reflection was found to be nearly the same for all (hkl)-reflections with exception of (111), (333), and (444). The study of broadening effects with the same instrument has been started. (auth)

4396

OPTICAL METHODS IN X-RAY ANALYSIS. I. THE STUDY OF IMPERFECT STRUCTURES. C. A. Taylor, R. M. Hinde, and H. Lipson. Acta Cryst. 4, 261-6(1951) May.

The correspondence between the diffraction of x rays by crystals and of light by gratings can be used to test hypotheses put forward to explain the x-ray diffraction patterns of imperfect structures. Two-dimensional gratings of holes in cardboard are made and their diffraction patterns observed in a specially constructed large spectrometer (the Bragg x-ray microscope). Illustrations are given of the application of the method to (a) the transition from the cubic to the hexagonal close-packed structure, and (b) the ordering process in the alloy $AuCu_3$. From the latter investigation it would appear that the x-ray diffraction effects observed can be accounted for entirely by changes in the degree of short-range order. Some rules are given for guidance in the interpretation of the x-ray diffraction patterns of imperfect structures. 17 plates. (auth)

4397

A PHOTOELECTRIC STRUCTURE-FACTOR MACHINE. M. M. Woolfson. Acta Cryst. 4, 250-2(1951) May.

Lipson & Taylor (Acta Cryst. 2, 130(1949)) have described a photoelectric device using Huggins' masks from which structure factors were derived with correct signs, but with some large errors in magnitude. The present paper includes a description of an investigation of these errors, together with an account of the preparation of more accurate masks and details of the construction and test of a larger and more versatile machine. In the new machine each atom is represented by one photocell with its output modified by a potentiometer to allow for the atomic number. An enlarged image of each mask in turn is projected onto this arrangement of cells, and the total potential developed, which is proportional to $F_{(000)} + F_{(hkl)}$, is measured by a galvanometer. The results obtained for durene with the few masks at present made show excellent agreement with both calculated and observed values. (auth)

4398
PROCESS INSTRUMENTATION FOR CRYSTAL GROWING EQUIPMENT. S. A. Hluchan. Instruments 24, 585-90(1951) May.

Equipment and a program control system for growing single crystals of the aromatic hydrocarbons is described. The need for and use of these crystals as detection elements for scintillation-type radiation instruments is treated briefly. The use of suppression voltage, thermopile activation, and successive shifting of control range with time are some of the features of the control system which permit process manipulations necessary for a satisfactory product. (auth)

4399
THE STRUCTURE OF GRAPHITIC CARBONS. Rosalind E. Franklin. Acta Cryst. 4, 253-61(1951) May.

By suitably varying the temperature of preparation it has been found possible to prepare a continuous series of structures intermediate in type between the nongraphitic carbons and graphite. Detailed investigations with x-ray powder photographs show that the structure of these graphitic carbons is intermediate between the three-dimensional crystalline structure of graphite and the "random layer structure" of the nongraphitic carbons. In the graphitic carbons the graphite-like layers are grouped in parallel packets within which there is a random distribution of orientated and disorientated layers. The interlayer spacing in the nongraphitic carbons is constant at 3.44 A, and in graphite it is constant at 3.354 A. In the graphitic carbons the apparent interlayer spacing decreases with increasing graphitization. But the apparent interlayer spacing is in reality a mean value. Whatever the degree of graphitization, the small groups of orientated and disorientated layers within the parallel-layer packet retain, in the main, the spacings characteristic of graphite and the nongraphitic carbons, respectively. Only among the first disorientation spacings on either side of a group of orientated layers is there a spacing of some intermediate value. (auth)

FLUORINE AND FLUORINE COMPOUNDS

4400
Ames Lab.
THE USE OF AMMONIUM BIFLUORIDE IN THE PREPARATION OF FLUORIDES FROM OXIDES. John Reed Long. Aug. 21, 1948. Decl. July 17, 1951. 39p. (AECD-3203; ISC-97)

A procedure is described for using NH_4HF_2 as a reactant for preparing anhydrous fluorides from ThO_2, ZrO_2, ZnO, and Pb_3O_4. Use of NH_4HF_2 in preparation of ThF_4 will give as high a yield as use of HF. It has the advantage of being less poisonous and corrosive, it is less bulky to handle than the unwieldy hydrogen fluoride cylinders, and it requires less reaction time. It has the disadvantage of necessitating the pulverization and intimate mixing of the reactants. The procedure involves the intimate mixing of the bifluoride with the finely pulverized oxide in a molar ratio of 8:1, and heating the mixture at a temperature of 500°C for a period of 2 hr. Any excess ammonium bifluoride is expelled under these conditions. An extensive literature review is included.

RARE EARTHS AND RARE-EARTH COMPOUNDS

4401
Ames Lab.
METALLURGY OF THE RARE EARTHS WITH PARTICULAR EMPHASIS ON CERIUM. Donald H. Ahmann. Feb. 14, 1950. Decl. July 16, 1951. 79p. (AECD-3205; ISC-68)

The general method for the preparation of Ce metal by the metallothermic process has been successfully applied for the preparation of the rare-earth metals. Optimum yields were obtained by reducing charges of chloride, with the corresponding amounts of I and Ca. Pure Ce, didymium (80% Nd, 10% Sm, 8% Pr, and 2% other rare earths), Nd, and Pr metals were prepared. The ingot metal produced in the reduction was well formed, with smooth sides and top, and it was free of occluded slag. An ingot of impure Y was prepared by the same process. A small amount of a Sm-Ca alloy was prepared by the reduction of samarium dichloride by Ca. A Zn alloy of Sm was produced and separated in low yields by the coreduction of Sm trichloride or trifluoride and $ZnCl_2$ by Ca. MgO, CaO, and BeO were tested as crucible materials; of these, MgO was most resistant to attack by the molten metals. By casting in crucibles of this oxide, metals of high purity could be obtained. Mo and Ta metals were also investigated as crucible materials. Ce heated to 1700°C in Ta and to 1400°C in Mo did not dissolve detectable amounts of the crucible material. The density of Ce metal containing 0.1% Ca was found to be 6.747 g/cc and the hardness was found to be 25 on the Knoop hardness scale. The workability of the metal is limited by the oxide inclusions introduced during recasting. The melting point of Ce, containing 0.1 to 0.2% Ca and 0.05 to 0.2% Mg was found to be 793 ± 5°C. A solid transformation occurred at 703 ± 10°C. Nd metal with 0.5% Ca and 1% Mg has a density of 6.999. The melting point of metal of this purity is 820 ± 10°C; no solid transformations were observed. The vapor pressure of Ce metal, from 10^{-5} to 10^{-3} mm Hg, was determined in the temperature range from 1460 to 1720°K. The calculated heat of vaporization of Ce was determined as 107.7 ± 2.0 kcal, and the calculated boiling point at atmospheric pressure as 2690 ± 70°K.

4402
Ames Lab.
THE PRODUCTION OF THE LIGHT RARE EARTHS IN THE MASSIVE METALLIC STATE. F. H. Spedding, H. A. Wilhelm, W. H. Keller, D. H. Ahmann, A. H. Daane, C. C. Hach, and R. P. Ericson. [nd] Decl. July 19, 1951. 20p. (AECD-3208; ISC-75)

A method is described which has been used to prepare Ce, La, Pr, and Nd metals in high purity in the massive state by reducing the appropriate rare earth chloride with Ca metal, using I as an auxiliary oxidant. Vacuum remelting of the product metal is employed to eliminate small amounts of Ca and Mn. Attempted reductions of Sm and Y halides have not been successful.

SEPARATION PROCEDURES

4403
Oak Ridge National Lab.
PRODUCTION OF FISSION PRODUCT IODINE 131. A. F. Rupp, E. E. Beauchamp, and J. R. Farmakes. July 17, 1951. 25p. (ORNL-1047)

The equipment and process used for the separation and purification of fission product I^{131} at ORNL are described. The effect of process variables is discussed in detail. (auth)

SPECTROSCOPY

4404
MOLECULAR SPECTRA AND MOLECULAR STRUCTURE. Gerhard Herzberg. New York, D. Van Nostrand Co., Inc., 1950. 658p.

This is the second edition of the original book, the first edition having been published in 1939. The outline of the book is almost precisely that of the earlier one. However, in revising the book, the author has added considerably to the wave mechanical contributions to the theory of the structure and spectra of diatomic molecules; added sections on

microwave spectroscopy, hyperfine structure of electronic energy levels, and intensities of electronic transitions; and modified discussions of experimental and theoretical developments. A more complete review of this book can be found in a book note appearing in J. Optical Soc. Am. 41, 211(1951) Mar.

SYNTHESIS

4405

Radiation Lab., Univ. of California

THE SYNTHESIS OF METHANOL-C^{14} AND METHYL IODIDE-C^{14} BY HIGH PRESSURE HYDROGENATION. P. T. Adams, R. E. Selff, and B. M. Tolbert. May 10, 1951. 8p. (UCRL-1289)

A procedure for converting $C^{14}O_2$ to methanol and methyl iodide by high-pressure hydrogenation of the Cd-Ni salt of formic acid is described. A pure product was obtained in good yield, and the method was found to be consistently reliable. (auth)

4406

Radiation Lab., Univ. of California

NOTES ON THE PREPARATION OF HYDROGEN CYANIDE-C^{14} FROM $BaC^{14}O_3$. R. E. Selff and B. M. Tolbert. May 17, 1951. 5p. (UCRL-1299)

Experimental details are presented on the preparation of $HC^{14}N$ from $BaCO_3$ by reduction with K metal in the presence of NH_3. The procedure used was essentially that of Cramer and Kistiakowsky (J. Biol. Chem. 137, 547(1941)), as modified by Loftfield (Nucleonics 1, No. 3, 54(1947)) except that dilute H_2SO_4 was used to generate the HCN. No difficulties were encountered, and yields of 80 to 90% were obtained.

TRANSURANIC ELEMENTS AND COMPOUNDS

4407

Radiation Lab., Univ. of California

SOME PHYSICAL AND CHEMICAL PROPERTIES OF CURIUM. (thesis) W. W. T. Crane. Apr. 16, 1951. Decl. May 24, 1951. 34p (AECD-3161; UCRL-1220)

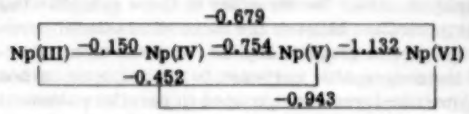
Improved methods of isolating Cm are outlined. The absorption spectrum of Cm^{+3} is given as well as most of the prominent lines in the arc and spark spectra. The method of production of Cm metal is outlined and the density is reported as 7. The molar magnetic susceptibility of CmF_3 has been found to be 24,000 ± 5000 cgs units in an environment of 296°K and 26,500 ± 700 cgs units in the same environment when the sample was diluted with 90% LaF_3. The susceptibility of CmF_3 is in agreement within experimental error of that expected theoretically for a $5f^7$ configuration. 20 references. (auth)

4408

Argonne National Lab.

THE THERMODYNAMICS OF NEPTUNIUM IONS IN PERCHLORIC ACID. Donald Cohen and J. C. Hindman. June 5, 1951. Decl. July 2, 1951. 18p. (AECD-3190; ANL-WMM-865)

Measurements have been made of the potentials of the Np(III)-Np(IV), Np(IV)-Np(V), and Np(V)-Np(VI) couples in molal perchloric acid as functions of temperature. The experimental procedures are described. The cell reactions for the couples are $Np(III) + H^+ \rightleftharpoons Np(IV) + \frac{1}{2}H_2$, $Np^{+4}(aq) + 2H_2O \rightleftharpoons NpO_2^+(aq) + 3H^+ + \frac{1}{2}H_2$, and $Np(V) + H^+ \rightleftharpoons Np(VI) + \frac{1}{2}H_2$. The results of the oxidation-potential measurements are summarized in the following potential scheme for Np ions in 1.0M $HClO_4$ at 25°C.



These are formal potentials corrected to unit activity for the hydrogen ions. Values for ΔF, ΔH, and ΔS are listed. The entropies of the Np ions are calculated and compared with those of U and Pu. The entropies found for Np fit into the general scheme.

URANIUM AND URANIUM COMPOUNDS

4409

Illinois Inst. of Tech.

THE REACTIONS OF METALS WITH GASES AND SALTS AT HIGH TEMPERATURES; TECHNICAL REPORT NO. 10. THE REACTION BETWEEN URANIUM AND OXYGEN. Daniel Cubicciotti. Apr. 1951. 15p. (NP-3208)

The rate of oxidation of U was determined in the temperature range 90 to 240°C. The reaction followed the parabolic oxidation law from 90 to 165°C and the linear above 165°C. The transition from parabolic to linear, observed in several oxidations, is considered. The transition is possibly due to cracking of the oxide film caused by excessive strain in the oxide. (auth)

ENGINEERING

HEAT TRANSFER AND FLUID FLOW

4410

Purdue Univ.

[HEAT TRANSFER]; FINAL TECHNICAL REPORT . . . FEBRUARY 16, 1950, TO FEBRUARY 15, 1951. Howard L. McGill, W. L. Sibbitt, H. K. Wiskind, and Spiridon Suciu. [nd] 121p. (ANL-4603)

Heat Transfer and Pressure Drop of Water Flowing in a Small Tube. The purpose of this investigation was to study the effects of high-density heat flux on pressure drop and limiting burnout point for upward flow of water in an electrically heated test section. The tests were made under the following conditions: inlet water temperature, 85 to 650°F; pressure, 250 to 3000 psig; velocity in test section, 0.6 to 40 fps; Reynolds' number, 1000 to 350,000; heat flux 36,900 to 4,480,000 Btu/hr/ft². The test section was made of 0.143-in. ID × 0.187-in. OD, type-304 stainless steel. The heated tube lengths were 24, 18, and 3 in. Operation was carried out in the nonboiling region, the nucleate boiling region, and into the film boiling region at burnout. 27 figures.

A Study of the Nitrogen-and-Water and Hydrogen-and-Water Systems At Elevated Temperatures and Pressures. The solubility of H_2 and N_2 in pure water was measured at 1000, 1500, and 2000 psig (under constant pressure conditions). The experiments covered the temperature range from room temperature to above 600°F. 14 figures.

Diffusion of Gases through Metals with Emphasis on the System Hydrogen–Stainless Steel (Type 347). H_2 gas readily diffused through boiler plate and low-carbon pipe metal. The H_2 may be produced by a number of methods: by the action of acid on the metal, by the electrolysis of an aqueous solution, and dry H_2 gas from a commerical source. The diffusion rates from the acidic solution and the electrolyte were very high, and the experimental values were usually erratic and not reproducible. The measured rates varied between 0.001 and 0.1 $cm^3/mm/hr/cm^2$. The diffusion of H_2 through type-347 stainless steel, over the temperature range of up to 500°F, was never observed in measurable quantities. The diffusion rate was less than 10^{-6} $cm^3/mm/hr/cm^2$ in most of the range below 600°F. Even in the case of the electrolyte no actual diffusion was observed. 19 figures.

4411

Oak Ridge National Lab.

HEAT TRANSFER IN NONCIRCULAR DUCTS; PART I. H. C. Claiborne. May 14, 1951. 44p. (ORNL-985)

This is the first of a planned series of reports on the analytical treatment of heat transfer to noncircular ducts with emphasis on liquid-metal systems. This report is concerned only with results for systems with fully developed hydrodynamic and thermal boundary layers; i.e., away from entrance effects. Analytical solutions for velocity distributions in the case of laminar or viscous flow are presented for rectangular, equilateral triangular, right isosceles triangular, elliptical and circle sector ducts. Analytical solutions are given for the temperature distribution in the case of slug flow in the type ducts mentioned for heat transfer at constant wall temperature and at uniform wall heat flux. In addition, the general right triangular duct problem is solved for the case of uniform wall flux. The applicability of these results to liquid-metal systems for a region of the turbulent regime is indicated. At uniform wall flux the average Nusselt modulus for slug flow was found to be 6, 4, 3, and 2 for rectangular, equilateral triangular, right isosceles triangular, and 30-deg right triangular ducts, respectively. (auth)

4412

FLUID FLOW THROUGH POROUS METALS. Leon Green, Jr., and Pol Duwez. J. Applied Mech. 18, 39-45(1951) Mar.

A method is outlined for correlating experimental data obtained in studies of the flow of gases and liquids through porous metals. The correlation is based upon the suggestion of Forcheimer (Z. Ver. deut. Ing. 45, 1781(1901)) that the pressure gradient attending the flow of a liquid through a porous medium can be expressed as a function of flow rate by a simple quadratic equation. An equation of this type defines two length parameters necessary for characterization of a porous structure and permits a general definition of the Reynolds number for a structure of arbitrary complexity. (auth)

MATERIALS TESTING

4413

PENETRATING-RADIATION METHODS [in Nondestructive Testing]. R. C. McMaster and S. A. Wenk. Materials & Methods 33, No. 2, 83-7(1951) Feb.

Penetrating radiation is one of several methods described for nondestructive testing of engineering materials. The advantages and limitations of the method and the sources available are touched upon. The author discusses the use of film radiography, xeroradiography, fluoroscopy, electronic reproduction of x-ray images, and point-by-point inspection using detectors such as ionization gauges or Geiger counters.

VACUUM SYSTEMS

4414

LEAK DETECTION WITH A MASS SPECTROMETER USING HYDROGEN GAS. M. E. Reinders, J. Schutten, and J. Kistemaker. Applied Sci. Research (Netherlands) 2B, No. 1, 66-70(1951).

The use of hydrogen gas as a testgas in leak detection with a leak-detecting mass spectrometer is discussed. The sensitivity of our instrument is found to be one part of hydrogen gas in 10^4 parts of air, this being five times less than for helium. (auth)

4415

A SYSTEM FOR HANDLING GASES WITHOUT STOPCOCK GREASE. Applied Sci. Research (Netherlands) 2B, 71-2 (1951) (Letter to the editor)

Brief report is made of the method used by the authors to handle the gases in a mass-spectrometer analysis of the deuterium content in H. The system of vertical tubes, with sintered disks and mercury which were used to avoid stopcocks, is diagramed.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

4416

Ames Lab.

SUMMARY OF RESEARCH ON EXPERIMENTAL REFRACTORY BODIES OF HIGH-MELTING NITRIDES, CARBIDES, AND URANIUM DIOXIDE. P. Chiotti. Apr. 23, 1949. Decl. July 16, 1951. 24p. (AECD-3204; ISC-44)

Procedures for the preparation of the nitrides of Be, La, Ta, Th, Ti, Zr, and U and the monocarbides of Nb, Ta, Ti, Zr, and U and the preparation of refractory bodies from them are described. Reasonably strong and dense bodies can be prepared from these materials as well as from UO_2. Evidence showing the tendency toward instability at high temperatures of Be_3N_2, TaN, and ThN is presented. Evidence is given indicating that the hexagonal structure reported by others for TaN is actually that for Ta_2N. A lattice for Th_2N_3 is proposed. The melting points of ThN, UN, and UC are determined to be 2630 ± 50°C, 2650 ± 100°C, and 2590 ± 50°C, respectively.

4417

North Carolina State Coll.

RELATION BETWEEN CRYSTALLIZATION AND DIELECTRIC PROPERTIES OF TITANIUM DIOXIDE IN GLASSY PHASES; JUNE 1, 1950-JUNE 1, 1951 (Technical Report No. 2). Ester M. Tuttle and Bobby L. Joyner. June 30, 1951. 26p. (NP-3217)

Maximum solubility of TiO_2 in Pb silicate at 1250°C was found to be 15% and in borosilicate 25%. The study of devitrification in these compositions provided a method of simulating the solubility-crystallization processes encountered in the firing of ceramic materials and of studying the effect of crystallization characteristics on the dielectric

properties. The rate of crystal growth was studied at several temperatures, and the temperature of maximum nucleation was determined for both glasses. The dielectric properties of specimens which had been heated at maximum nucleation and crystal growth temperatures were correlated with x-ray and petrographic data. The apparatus used for rate of crystal growth determinations is diagramed. It was found that distribution of the glassy phase and the nature and orientation of crystals contributed to the dielectric response. Thermal treatment in the temperature region of maximum nucleation rather than of maximum crystal growth promoted a high dielectric constant. The correlation of data suggested the occurrence of supersaturation followed by solution and recrystallization as the thermal treatment at crystallizing temperatures was continued.

GEOLOGY AND GEOPHYSICS

4418

Argonne National Lab.

AGE OF TEKTITES. Richard J. Hayden, Mark G. Inghram, and Hans E. Suess. Apr. 17, 1951. 3p. (AECU-1376; UAC-380)

An investigation has been made of the argon content of tektites utilizing the mass-spectrometric isotopic-dilution technique in an attempt to find a clue as to the origin of these supposedly meteoric glasses. The ages obtained are based on a value of 1.33×10^9 yr for the half life of K^{40}, a value of 7.92 for the ratio of decay to Ca as compared to the decay to A, and a value of 0.0119% for the abundance of K^{40}. The results of measurements on one australite ($< 32 \times 10^6$ yr) and two philippinite ($< 73 \times 10^6$ and $< 10 \times 10^6$ yr) samples show that the tektites are definitely much younger than the solar system and also that they are much younger than the ordinary meteorites which have been dated by means of He content.

METALS AND METALLURGY

4419

Ames Lab.

SOME STUDIES ON THE URANIUM-THORIUM-ZIRCONIUM TERNARY ALLOY SYSTEM. Oscar Norman Carlson. June 5, 1950. Decl. July 17, 1951. 72p. (AECD-3206; ISC-102)

Alloys of the U-Th-Zr system have been investigated by thermal, microscopic, and x-ray methods. The U-Th binary system has been studied and a phase diagram proposed. In this system there is a eutectic at 1086°C and 3 wt % Th. A region of liquid immiscibility exists above 1375°C between the compositions 8 and 72 wt % Th. A method of determining the boundary of the liquid area has been described. This method consisted, briefly, in maintaining the alloys at a constant temperature allowing the two liquid layers to separate and determining the composition of each layer by chemical analysis. The Th liquidus, which rises sharply from the eutectic, was determined in a similar manner. Excess solid Th was immersed in molten U at fixed, elevated temperatures until equilibrium was established. From chemical analysis the amount of Th dissolved was ascertained, establishing a point on the liquidus curve. The Th-Zr binary system has also been investigated and a phase diagram, likewise, has been proposed. There is a minimum in the solidus-liquidus curves at 1275°C and 25 wt % Zr. The solid solubility of Zr in Th has been estimated from x-ray measurements and from microstructures to be about 5 wt % Zr. The solubility of Th in α Zr appears to be negligible. Above 900°C in the region of β Zr the solid solubility in either component is more extensive. Microscopic examination of alloys quenched from above 900°C indicates that a continuous solid solution region lies beneath the solidus line. Some evidence for a high temperature allotropic form of Th has been presented and its possible existence discussed. There is a eutectoid at 70 wt % Zr and 645°C. The literature of the U-Zr system has been reviewed. β Zr and γ U have been reported to exhibit extensive solid solubility in one another. Present investigations indicate that a eutectoid point exists at 687°C and approximately 10 wt % Zr. 26 references. (auth)

4420

EFFECTS OF PRECOMPRESSION ON THE BEHAVIOR OF THE ALUMINUM ALLOY 24ST4 DURING CYCLIC DIRECT STRESSING. S. I. Liu. J. Metals (N. Y.) 3, 452-6(1951) June.

Experiments have shown that (1) Cyclic straining of resolution heat-treated 24ST4 creates two superimposed and counteracting effects, namely, strain hardening and deterioration. After small amounts of precompression, strain hardening prevails during the first few cycles, while after large precompression, deterioration prevails from the first cycle. (2) When acting alone, either of the two factors, precompression or cyclic straining, causes a reduction in fracture stress of this material; on the other hand, when acting together, the combined effect is greater than the sum of two individual effects. (3) Within the range of precompression and the number of cycles investigated, precompression accelerates the approach of fracture. (4) Cyclic straining permanently damages the material. (5) A pronounced yield jog appears after repeated tension cycles, and the flow and fracturing characteristics are slightly lowered. This yield jog is not present in the virgin unstrained metal. 15 graphs. (auth)

4421

THE ENTROPIES OF MELTING OF METALS. R. A. Oriani. J. Chem. Phys. 19, 93-7(1951) Jan.

The melting process can be conceived as consisting in first an expansion and then a disordering of the crystalline structure. The entropy contribution from the first effect is calculated by analogy with the process occurring in a volume expansion within an individual phase; the entropy contribution from the melting disorder is then obtained by difference from the measured entropy of fusion. Tentative conclusions of heuristic value are drawn from the relative magnitudes of the various quantities. A simple model for the melting process is adopted, making possible a correlation between the amount of disordering during melting and the structural contribution to the entropy of melting. (auth)

4422

THE EVAPORATION OF TITANIUM. L. G. Carpenter and W. N. Mair. Proc. Phys. Soc. (London) 64B, 57-66(1951) Jan.

Data are presented on the evaporation rate of β titanium over the temperature range 1,650-1,810°K. These are represented by $\log ET^{1/2} = -\frac{2.42}{T} + 9.79$, where E is in g/cm²/sec and T is in degrees Kelvin. The latent heat of vaporization is deduced both from the measured values of evaporation rate, together with known thermodynamic functions of the solid and gas, and also from the temperature coefficient of evaporation rate. An estimate is made of the variation of total radiation with temperature and of the vapor pressure at the melting point. Experimental details are given. (auth)

4423

HIGH DENSITY METAL. Materials & Methods 33, No. 2, 101(1951) Feb.

Very brief note is made of a new noncutting metal called "Hevimet," which is heavier than cemented carbide and is said to possess a 50% greater density than Pb. Produced

by Carboloy Co., Inc., Detroit, it is of use for γ-ray screens used in radiotherapy, for example.

4424

LATTICE AND GRAIN BOUNDARY SELF-DIFFUSION IN SILVER. R. E. Hoffman and D. Turnbull. J. Applied Phys. 22, 634-9(1951) May.

The lattice and grain boundary self-diffusion coefficients of high-purity silver have been measured over extended temperature ranges. It has been found that the lattice diffusion coefficients are described by the equation $D_L = 0.895 \exp(-49{,}500/RT) cm^2 sec^{-1}$ and are independent of the thermal history of the crystals within wide limits. The absolute grain boundary diffusion coefficients fit the equation $D_B = 0.03 \exp(-20{,}200/RT) cm^2 sec^{-1}$ and are independent of the grain size of the specimens. (auth)

4425

Battelle Memorial Inst.

LOW-MELTING GALLIUM ALLOYS. R. M. Evans and R. I. Jaffee. Apr. 6, 1951. Decl. July 16, 1951. 15p. (BMI-RIJ-2)

The low melting point and high boiling points of Ga make it of interest as a liquid-metal heat-transfer medium. The only alloying elements which are suitable for use in nuclear power plants, and, at the same time, further lower the melting point of Ga, are Sn, Al, and Zn. The low-melting Ga alloys with these elements were investigated. Al was found to be unsuitable, because it made the Ga alloys susceptible to excessive drossing. Sn and Zn were found to form a ternary eutectic with Ga, located at 82Ga-12Sn-6Zn, melting at 17°C. The liquidus surface of this system was determined. These data show how to dilute the ternary eutecti with Zn with minimum increase in melting point. Pb-Sn was also investigated as a diluent and appeared to be slightly better than Zn. In the course of this work, it was found that As, Ca, Ce, Mg, Sb, Si, and Tl do not lower the melting point of Ga. The corrosivity of Ga is so great that the only metals capable of containing it at elevated temperatures are W and Ta. The Ga-Sn-Zn eutectic is somewhat less corrosive, but still appears to be too corrosive to permit its use as a liquid-metal heat-transfer medium. (auth)

4426

ON ANTIFERROMAGNETISM IN A SINGLE CRYSTAL. N. J. Poulis, J. van den Handel, J. Ubbink, J. A. Poulis, and C. J. Gorter. Phys. Rev. 82, 552(1951) May 15. (Letter to the editor)

Hydrated copper chloride $CuCl_2 \cdot 2H_2O$ apparently becomes antiferromagnetic at a temperature slightly above the boiling point of liquid He. Single crystals of this substance have been investigated by three different magnetic methods at a number of liquid He temperatures. The symmetry of the resonance diagram appears to suggest the existence of two spin systems with antiparallel orientations which interchange their directions only slowly.

4427

PHYSICS AND METALLURGY; trans. from Metallurgia 4, 171-8(1950). G. Masing. 1950. 26p. (NP-2310)

The application of physical techniques to the field of metallurgy is discussed. The works of various investigators which have contributed to modern metallurgy theory are considered. 17 references.

4428

THEORY OF D_0 FOR ATOMIC DIFFUSION IN METALS. Clarence Zener. J. Applied Phys. 22, 372-5(1951) Apr.

The theory of the entropy of activation ΔS previously given for interstitial diffusion in metals is herein extended to self- and to chemical diffusion. It is concluded that this entropy of activation will always be positive; and it is shown that in the case of self-diffusion and of chemical diffusion at very low concentrations, the better the empirical ΔS the better does it correlate with the theoretical positive ΔS. The large negative apparent ΔS frequently found for chemical diffusion at higher concentrations must be attributed either to inaccuracies in experiments or to the presence of short circuiting diffusion paths. It is predicted that the presently reported negative values of ΔS will become positive when very small concentrations are used in large grain-size specimens. (auth)

4429

Atomic Energy Research Establishment, Harwell, Berks. (England)

THE TRAPPING OF GASES IN COLD COMPACTED POWDERS. J. Williams. Apr. 5, 1951. 18p. (AERE-M/R-687)

Investigations have been carried out into the state of the gases present in cold-pressed compacts of Fe and ThO_2. In the case of Fe powder, it is shown that about 80% of the gases originally present between loosely packed particles may be mechanically entrapped during compacting, the pressure of the entrapped gases increasing as the compacting pressure is raised. Effusion of these gases from the compact occurs subsequently on standing in air, the time to attain equilibrium with the external atmosphere increasing with rising compacting pressure. The experimental method used for Fe powders is not able to distinguish mechanically entrapped gases in ThO_2 compacts, owing to the interference of very considerable amounts of adsorbed gases. The amount of such adsorbed gas increases with time of standing prior to extraction. An explanation of this effect is put forward based on the relaxation with time of the interparticle bonding forces within the compact, and the creation of fresh surfaces allowing access of gas to these surfaces. (auth)

MINERALS AND MINERALOGY

4430

Minnesota Univ.

ANNUAL REPORT FOR PERIOD JUNE 8, 1949, TO JULY 1, 1950. John W. Gruner and Lynn Gardiner. July 28, 1950. 35p. (RMO-612)

The geology and mineralogy of the hydrothermal U deposits near Marysvale, Piute County, Utah, are described. The very unusual combinations of pitchblende-sulfide ores in Triassic sandstones at the Happy Jack Mine in White Canyon, Utah, and their possible origin are discussed. Investigation of the shales below and above the Shinarump shows that no low grade U deposits are to be expected in them. Experiments at temperatures around 200°C show that pitchblende may form in uranyl solutions if H_2S is the reducing agent. Natural goethite in finely divided form is closely associated with amorphous Cu and U compounds as proved by experiments. This is one of the forms in which U occurs in the sandstones of White Canyon and probably Hack Canyon. Experiments dealing with adsorption of U salts by finely divided compounds reveal that the decay products are easily absorbed. U on the other hand is adsorbed in considerable quantities only by bentonite, phlogopite, and artificial MgO. (auth)

4431

Raw Materials Operations, AEC

MINERALOGICAL STUDIES OF URANINITE AND URANINITE-BEARING DEPOSITS; JULY 1, 1949 - JUNE 30, 1950. Paul F. Kerr. July 1, 1950. 61p. (RMO-715)

The ore uraninite has been studied in some detail. Work by various investigators indicates a considerable range of

measurements for the lattice constants of uraninite. Causes of these variations have been investigated and are discussed. X-ray diffraction patterns of different uraninite specimens and of U oxides are shown. Structural changes obtained by heating artificial UO_2, UO_3, U_3O_8, and hard lustrous uraninite are shown diagrammatically. A number of differential thermal curves are illustrated representing uraninite specimens, thorianite, and the oxides UO_2, UO_3, and U_3O_8. Photographic plates show the changes in crystallization corresponding to stages in the thermal analyses. Results are discussed of investigations of U-bearing veins at Beaverlodge Lake, Saskatchewan, and at Sunshine Mine, Coeur D'Alene District, Idaho. A brief account is given of studies of the minerology of the Ra vein and of the wall rock bordering the Ra vein at the Caribou Mine.

4432

Minnesota Univ.

THIRD PROGRESS REPORT, FOR PERIOD MARCH 1 TO JULY 1, 1950. John W. Gruner and Lynn Gardiner. July 28, 1950. 14p. (RMO-746)

A brief discussion is made of geological and mineralogical observations at White Canyon No. 1 claim, White Canyon, Utah, and at Hack Canyon, 50 miles southwest of Fredonia, Ariz. Results of preliminary studies of U-bearing micaceous sandstone at Monument No. 2 Mine, Monument Valley, Utah, and the extraction of U from Happy Jack ores are also discussed briefly.

4433

Minnesota Univ.

FOURTH PROGRESS REPORT, FOR PERIOD JULY 1 TO NOVEMBER 1, 1950. John W. Gruner and Lynn Gardiner. Nov. 28, 1950. 25p. (RMO-747)

Data have been collected and certain conclusions reached as to the state of U in natural asphaltic and lignitized materials. Mineralogical observations have been recorded on samples from the Happy Jack Mine, Hack's Canyon Prospect, Posey Group Claims, and others. Pitchblende and basic U sulfates, corresponding to some natural ones, have been synthesized. (auth)

4434

Minnesota Univ.

FIFTH PROGRESS REPORT, FOR PERIOD NOVEMBER 1, 1950, TO FEBRUARY 28, 1951. John W. Gruner and Lynn Gardiner. Mar. 12, 1951. 35p. (RMO-748)

A detailed mineralogical description is given of samples of the new discoveries near Grants, New Mexico. The occurrence of pitchblende in chalcocite from Fry Canyon, San Juan County, Utah, and the occurrence of autunite or metaautunite near Goulding, Monument Valley, Utah-Arizona are discussed briefly. Experiments show that Ca is absent in U sulfate minerals under the conditions tried. U hydrated oxides frequently form from sulfate solutions instead of the expected basic sulfates. Glassy sulfates of U and probably glassy vanadates made in the laboratory suggest the occurrence of such compounds in nature. Pitchblende has been synthesized at 80 to 85°C under conditions which probably correspond to natural ones.

4435

DETERMINATION OF URANIUM CONTENT IN HYALITE OPALS AND OTHER MINERALS WITH THE AID OF FLUORESCENCE ANALYSIS. H. Haberlandt and F. Hernegger. Sitzber. Akad. Wiss. Wien, Math.-naturw. Klasse, Abt. IIa 155, 359-70(1947). (In German)

A comparison of fluorescence spectra produced by ultraviolet light in hyalites of various geologic origin permitted a quantitative determination of the U content in these minerals. Whereas pegmatitic hyalites contain 4 to 6.4×10^{-4} g of U per g of mineral, a hyalite formed on basalt was found to contain only 4.8×10^{-7} g/g. By the same method U was detected and quantitatively determined in certain hydrous aluminum phosphates (evansite and fisherite) and in zinc arsenates (adamite). The intensity of the fluorescence depends on the U content. The position of spectral bands due to the U complex is identical in all hyalites examined and in autunite, while in evansite the bands are displaced toward the shorter waves and in adamite and an artificial U glass are displaced toward the longer waves.

4436

National Bureau of Standards

FLUORINE SUBSTITUTION IN HYDROUS SILICATES AND RELATED MINERALS. A. Van Valkenburg and R. Pike. [nd] 11p. NBS-1061

A progress report on work being done toward the synthesis of mica and other useful silicates by substitution of F for OH groups, a process which could be done without using high vapor pressure, is presented. Under such conditions fluo-tremolite, cuspidine, chondrodite, and norbergite were made; experiments with tourmaline, garnet, and chrysotile were not successful. A study has been made, in the course of this work, of methods of chemical analysis for F. In this work, analyses have been made of topaz, cuspidine, and a F-containing montmorillonite. Discussions of the possibility of F substitution in other silicates considering crystal structure and other characteristics, are included.

4437

SIMPLE FIELD TESTS FOR BERYL. I. H. Spector and D. F. Brown. Precambrian 24, 13-15(1951) June.

A spot test to differentiate Be from other minerals which uses NaOH pellets and quinalizarin dissolved in acetone is described. A modification of the test determines whether a sample contains more or less than 1% BeO.

4438

SIMPLE FIELD TESTS FOR BERYL. N. E. Barlow. Precambrian 24, 13-15(1951) June.

A relative-density test devised to differentiate between massive Be and quartz using a diffusion column of bromoform (which may be replaced by acetylene tetrabromide) and benzene is described.

4439

X-RAY EXAMINATION OF URANOTHORITE. A. Pabst. Paper presented at the 31st Annual Meeting of the Mineralogical Society of America, Washington, D. C., Nov. 16-18, 1950.

An abstract of this paper appeared in Am. Mineral. 36, 323-4(1951) Mar.-Apr. and is reproduced here in its entirety.

Earlier x-ray studies of thorite have indicated that it is metamict (Vegard, Phil. Mag. 32, 65(1916)) or have led to cell dimensions (Boldyrev et al., Leningrad, Inst. Mines, Ann. 11, 1(1938)) that seem very much out of line with those of related materials. Single-crystal x-ray diffraction patterns have been obtained from unaltered uranothorite from Gillespie's Beach, South Westland, New Zealand. Rotation patterns on the a and c axes are very similar to zircon patterns but show a certain amount of streaking of the spots along "powder arcs." A cell of dimensions $a_0 = 7.12$ A, $c_0 = 6.32$ A contains $4ThSiO_4$. Th is replaced by U in the ratio of about 1/7. Observed and calculated densities agree at 6.7 ± 0.05. The space group is $D_{4h}^{19}-I4/amd$. The similarity of the rotation patterns to those of zircon leaves no doubt that the structure of this uranothorite is of the H3 (zircon) type.

PHYSICS

4440
Los Alamos Scientific Lab.
CHARACTERISTICS OF COMMERCIAL OPTICAL GLASS. Berlyn Brixner. Mar. 20, 1951. 87p. (LA-1222)

A very extensive standardized tabulation of all commercially produced optical glasses is presented. The tables of indices give the values of n_B (or n_A), n_c, n_e, n_F, n_G, and n_h for each of the glasses. From the six indices the V, P, Δn, and n/V values were calculated for the spectral range B to e for use with red filtered pan film, C to G′ with pan film, e to h with ortho film, and F to h with color-blind film.

4441
North American Aviation, Inc.
ON THE ELASTIC CONSTANTS OF SIMPLE METALS. G. J. Dienes. May 15, 1951. 11p. (NAA-SR-125)

The Morse function has been investigated as an interaction potential function from which the elastic constants of simple body centered cubic metals may be derived. The calculations indicate that the elastic coefficients of Na and K are very satisfactorily derivable from such a potential function. The elastic coefficients are less accurately fitted in the case of Fe. Compressibility-pressure data and the temperature coefficients of the elastic constants cannot be accounted for by a change in the interatomic distance alone. The indicated changes in the constants of the Morse function are in such a direction that, by employing a Morse function fitted to the elastic coefficients, the interatomic interactions at small interatomic distances are somewhat underestimated. (auth)

4442
Princeton Univ.
LIMIT ON NEUTRINO MASS FROM TRITIUM BETA SPECTRUM. Donald R. Hamilton, W. P. Alford, and Leonard Gross. Mar. 12, 1951. 1p. NYO-784

The report is reproduced here in its entirety.

A hemispherical electrostatic integral β spectrograph (Hamilton and Gross, Rev. Sci. Instruments 21, 912(1950)) (energy resolution 120 v at 20 kv) has been used to investigate the tritium spectrum (Curran, Angus, and Cockroft, Phil. Mag. 40, 53(1949); Hanna and Pentecorvo, Phys. Rev. 75, 983 (1949)) near the end point. The strongest source used (tritium in Zr) has essentially infinite thickness for tritium electrons. The spectrum of this source is distorted at voltages more than 1.5 kv below the end point; to within experimental error the spectrum for the last 1.5 kv agrees with that to be expected for zero neutrino mass; preliminary results give (neutrino mass) $\leq$ 250 ev = (electron mass)/2000. A thinner and less intense source gives an undistorted spectrum down to 10 kv and (neutrino mass) $\leq$ 500 ev. The end point is found to be 19.4 $\pm$ 0.4 kv, the uncertainty arising in the absolute voltage calibration.

4443
Oak Ridge National Lab.
QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. M. E. Rose, ed. Mar. 15, 1951. 54p. (ORNL-940)

Separate abstracts have been prepared on the following sections of this report: Neutron Diffraction, sect. 1; Nuclear Alignment Program, sect. 2; Short-period Activities, sect. 3; Short-lived Isomers, sect. 4; Investigations with the Scintillation Spectrometer, sect. 5; Accelerator Program, sect. 6; Stable-Isotope Cross Sections, sect. 7; Neutron Electric Dipole Moment, sect. 8; Theoretical Physics, sect. 9.

4444
Radiation Lab., Univ. of California
PARAMAGNETIC RESONANCE IN ALKALI METAL SOLUTIONS AT LOW FIELDS. E. C. Levinthal, E. H. Rogers, and R. A. Ogg, Jr. Apr. 6, 1951. 4p. (UCRL-1240)

Paramagnetic resonance in solutions of Na in liquid ammonia and in solutions of Li in methylamine and in ethylenediamine has been investigated. The principal experiments were performed at a frequency of 49.0 Mc in a precission field of approximately 17.5 gauss. Results indicate the dependence of signal width and amplitude upon concentration and temperature of the solutions.

4445
Radiation Lab., Univ. of California
SUMMARY OF THE RESEARCH PROGRESS MEETING OF JANUARY 18, 1951. Margaret Foss Folden. June 26, 1951. 4p. (UCRL-1245)

Physics reports from Duke University included descriptions of level separations in compound nuclei after absorption of a neutron and of studies of rising levels of excitation measured by time of flight. The disappearance rate of P^{32}, labeled chromic phosphage colloid, injected into the blood has been used to obtain a measure of the rate of blood flow through the liver. A method using photographic masks with patterns corresponding to typical terms in Fourier summations for interpretation of studies on the density of electrons was described.

COSMIC RADIATION

4446
ANGULAR DISTRIBUTIONS OF SHOWER PARTICLES AS A FUNCTION OF DEPTH. L. Eyges and S. Fernbach. Phys. Rev. 82, 287-8(1951) Apr. 15. (Letter to the editor)

Calculations have been made of the angular distributions of high-energy electrons and photons in air showers as a function of depth in the shower. To do this, the authors first calculated the moments of these functions and then reconstructed the distribution functions from the moments. Results are tabulated. Except very near the origin, values are probably accurate to within several per cent.

4447
COMPOSITION OF THE HARD COMPONENT OF COSMIC RAYS IN THE STRATOSPHERE. N. L. Grigorov. Doklady Akad. Nauk S.S.S.R. 76, No. 3, 381-4(1951). (In Russian)

Technical difficulties still make it impossible to measure directly the flux of fast μ mesons at high altitudes. The usual indirect way is to obtain that flux as a difference between the total intensity of the hard component and the intensity of the primary, shower-producing particles. The inaccuracy of this method is shown in a calculation that also indicates a better way of estimating the intensity of the μ-meson component in the stratosphere as a function of the altitude. The estimation shows that, besides μ mesons, there is present a comparable quantity of other particles which do not disintegrate and do not produce showers; they are probably identical with secondary protons of relatively low energy, observed by Adams et al. (Revs. Modern Phys. 20, No. 1(1948)).

4448
COSMIC-RAY BURSTS AND THE NUCLEONIC CASCADE. G. N. Whyte. Phys. Rev. 82, 204-8(1951) Apr. 15.

The cosmic-ray burst rate has been measured as a function of altitude at geomagnetic latitudes of 0, 29, and 35°N

by means of a thin-walled spherical ionization chamber. The burst rate at an atmospheric depth of 20 g/cm² increases by a factor of 6 between 0 and 52°. When the data are corrected for the effects of heavy primary nuclei, the residual rates, believed due almost entirely to nuclear disintegrations, show maxima below the top of the atmosphere. The maxima at 0, 29, 35, and 52° occur at depths of approximately 100, 70, 60, and 50 g/cm², respectively. (auth)

4449

COSMIC-RAY NEUTRONS. Serge A. Korff. Am. J. Phys. 19, 226-9(1951) Apr.

The discovery of neutrons produced by the cosmic radiation is reviewed, and the evidence today available is summarized. The life history of a neutron in the atmosphere is discussed, as is its eventual capture to form radiocarbon. The latitude effect and altitude dependence are presented. Some of the possible production processes are discussed. Coincidence experiments in the production of cosmic-ray stars indicate that neutrons are often produced more than one at a time. 15 references. (auth)

4450

COSMIC-RAY NUCLEON-NUCLEON COLLISIONS IN PHOTOGRAPHIC EMULSIONS. E. Pickup and L. Voyvodic. Phys. Rev. 82, 265(1951) Apr. 15. (Letter to the editor)

Four events in Ilford G5 emulsions exposed at about 85,000 ft are described. These events show only relativistic or near-relativistic singly charged particles with a typical forward shower cone and none of the usual low-energy disintegration products. It seems likely that most of these and similar recorded events represent partial collisions with the heavier nuclei in the emulsion.

4451

EMULSION STUDIES OF COSMIC-RAY STARS PRODUCED IN METAL FOILS. Ian Barbour. Phys. Rev. 82, 280-1(1951) Apr. 15. (Letter to the editor)

A report has been made (Phys. Rev. 79, 406(1950); NSA 4-5695) of a method in which cosmic-ray-induced disintegrations of nuclei of several elements were studied with metal foils "sandwiched" between pairs of G5 emulsions placed face-to-face. Results are now presented in the form of graphs, with integral cross section per target nucleus plotted against number of prongs per star and against atomic weight of the target.

4452

EVIDENCE OF LONG-RANGE SECONDARY ELECTRONS ACCOMPANYING COSMIC RAYS IN A PROPORTIONAL COUNTER. S. D. Chatterjee. Phys. Rev. 82, 114-15(1951) Apr. 1. (Letter to the editor)

Experimental evidence is presented which indicates the emission of secondary electrons, accompanying cosmic rays, within the gaseous volume of the proportional counter. From typical curves, where the ratio of the quadruple to triple coincidences has been plotted as a function of the voltage on the proportional counter, a value of 9% has been obtained to represent the percentage of secondary electrons accompanying the primary particles. This value is compared with the value of 11% deduced theoretically according to Swann's method (J. Franklin Inst. 249, 133(1950)).

4453

A NOTE ON THE DEVELOPMENT OF THE NUCLEON COMPONENT OF THE COSMIC RADIATION IN AIR WHEN IONIZATION LOSSES ARE ACCOUNTED FOR. H. Messel. Phys. Rev. 83, 26-30(1951) July 1.

The development of the nucleon component of the cosmic radiation in air is considered in terms of a model previously discussed by Messel and Ritson, with the inclusion of ionization losses. The results obtained are compared with experiment, and good qualitative agreement is found. The good qualitative agreement found strongly suggests that the Heitler-Jánossy assumptions regarding the nucleon-nucleon collision cross section are valid. But from a quantitative standpoint it appears that a number of points require revision. There is little doubt that the development of the nucleonic component can in fact be well accounted for in terms of a cascade process. Results are presented in graphic form for neutrons, protons, neutrons plus protons and their ratio. (auth)

4454

ON THE ABSORPTION OF PENETRATING SHOWERS. H. A. Meyer, G. Schwachheim, and A. Wataghin. Phys. Rev. 82, 424-7(1951) May 1.

Several experiments on the absorption in lead of the particles of penetrating showers have been performed under different geometrical conditions. The penetrating showers produced in air are shown to have a high penetrating power, whereas those produced locally are strongly absorbed. An interpretation is given by the study of the selection of the penetrating showers by our apparatus. The cross section for nuclear absorption of the π mesons of the locally produced penetrating showers was measured and shown to be smaller than half the geometrical one. Some data on the structure of the penetrating showers and on the presence of photons were obtained. (auth)

4455

ON FERMI'S THEORY OF THE ORIGIN OF COSMIC RADIATION. Chang-Yun Fan. Phys. Rev. 82, 211-16(1951) Apr. 15 (See also NSA-4-6155)

Starting from Fermi's theory of the origin of cosmic radiation, an explanation of the observed shape of the energy spectrum of the proton component is suggested. On this basis there seems to be some indication that the majority of the protons originate from the nucleus of our galaxy. Assuming that the nucleus of the galaxy is a cluster of stars, the origin of the heavier nuclear components and protons of cosmic radiation can be explained on the same basis provided that an ordinary star can eject high energy particles (up to 1 Bev per nucleon). The observation of the effect of the sun on the heavier nuclear components may give a critical test of the theory. The trapping magnetic field, if any, of the galaxy has a negligible effect on the energy spectra of cosmic radiation observed on the earth. The age of the galaxy is estimated to be greater than two billion years. (auth)

4456

Commissariat à l'Energie Atomique

ON THE POSSIBLE EXISTENCE OF PRIMARY COSMIC SHOWERS; reprint from Compt. rend. 232, 328-30(1951). Anatole Rogozinski. Jan. 22, 1951. 6p. (CEA-65)

Certain explosion pictures in photoemulsions point to the existence of "composite" primary cosmic particles, or "primary showers." It can be surmised that such a picture represents a quasi-simultaneous arrival of some descendants of products of a nuclear explosion that took place in the interstellar space. Only photons, formed in the decay of neutral π mesons, can be the descendants capable of producing the effect in question. It is probable that in the earth atmosphere a primary shower can generate a gigantic composite atmospheric shower several kilometers in diameter.

Bound with this report is the article, Radio Telemetering of Coincidences Between Distant Counters by E. Picard, A. Rogozinski, and M. Surdin, an abstract of which appeared in Nuclear Science Abstracts as NSA 5-2831.

4457

ON THE PROTON COMPONENT OF THE VERTICAL COSMIC-RAY BEAM AT SEA LEVEL. M. G. Mylroi and J. G. Wilson. Proc. Phys. Soc. (London) 64A, 404-17(1951) Apr.

Approximately 1% of the vertical cosmic-ray intensity at sea level is shown to consist of protons. These form a momentum spectrum of index −2.8 in the range 10^3 Mev/c $< p < 5 \times 10^3$ Mev/c and have an absorption range in Pb of 160 ± 40 g/cm². Using existing measurements at high altitude, the attenuation in the atmosphere of protons in the spectral region investigated is found to take place with a range 140 ± 10 g/cm². There is no negatively charged component of strong nuclear interaction in the vertical beam of intensity as great as 0.1% of the whole beam. (auth)

4458
PHOTOGRAPHIC EMULSION STUDIES OF THE LATITUDE EFFECT. K. R. Dixit. Indian J. Phys. 24, 501-6(1950) Nov.

Nuclear emulsions exposed and studied under identical conditions except for a change of 39° in the magnetic latitude show a significant difference of about 43% in the number of single tracks ($>100\,\mu$). The experiments appear to suggest that the causes which produce the stars and the singles ($>100\,\mu$) at an altitude of 2200 m are independent of one another. (auth)

4459
RADIAL DISTRIBUTION OF SHOWER ELECTRONS AS A FUNCTION OF DEPTH. Sidney Fernbach. Phys. Rev. 82, 288-9(1951) Apr. 15. (Letter to the editor)

The radial distribution of shower electrons has been determined in the same way as the angular distribution (L. Eyges and S. Fernbach, Phys. Rev. 82, 287(1951)). The procedure is somewhat more involved in that one must calculate the mixed radial and angular moments before obtaining the radial moments alone. In a previous paper (Phys. Rev. 82, 23(1951)) Eyges and Fernbach discussed this calculation for the shower maximum. The two cases which correspond approximately to half and twice the depth at the shower maximum have now been calculated and the results tabulated.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

4460
Oak Ridge National Lab.
NEUTRON DIFFRACTION, sect. 1 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. C. G. Shull, E. O. Wollan, and W. C. Koehler. Mar. 15, 1951. 3p. ORNL-940(sect.1)

Utilizing the fact that electronic and nuclear scattering are very nearly equal in the (220) reflection from Fe_3O_4 it has been possible to obtain neutron beams with essentially 100% polarization. It has also been demonstrated that the Fe_3O_4 lattice shows antiferromagnetic coupling. The coherent and total scattering cross sections of N^{14} have been measured; their approximate equality (9.1 and 10.3 barns) shows weak spin dependence of the nuclear forces in this case. (auth)

4461
Oak Ridge National Lab.
NUCLEAR ALIGNMENT PROGRAM, sect. 2 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. S. Bernstein, L. D. Roberts, J. W. T. Dabbs, Jr., C. P. Stanford, and T. E. Stephenson. Mar. 15, 1951. 4p. ORNL-940(sect.2)

Preparations are being made to utilize the 100%-polarized neutron beams to detect possible changes in the Mn cross section due to nuclear alignment. An a-c field is being utilized to flip the direction of the polarized neutron spins. Measurements of the entropy of $Mn(NH_4)_2(SO_4)_2$ as a function of field and temperature have been carried out as an aid in determining the degree of nuclear alignment. According to preliminary results, Hf shows no superconductivity in the region $0.16 < T < 4.2$, contrary to the results of Kurti and Simon. Further investigation with Hf of higher degree of purity is planned. (auth)

ELECTRONS

4462
A COLLECTIVE DESCRIPTION OF ELECTRON INTERACTIONS. I. MAGNETIC INTERACTIONS. David Bohm and David Pines. Phys. Rev. 82, 625-34(1951) June 1.

A new approach to the treatment of the interactions in a collection of electrons is developed, which is called the collective description. The collective description is based on the organized behavior produced by the interactions in an electron gas of high density; this organized behavior results in oscillations of the system as a whole, the so-called "plasma oscillations." The collective description, in contrast to the usual individual particle description, describes in a natural way the long-range correlations in electron positions brought about by their mutual interaction. In this paper attention is confined to the magnetic interactions between the electrons; the coulomb interactions will be discussed in a subsequent paper. The transition from the usual single-particle description to the collective description of the electron motion in terms of organized oscillations is obtained by a suitable canonical transformation. The complete hamiltonian for a collection of charges interacting with the transverse electromagnetic field is re-expressed as a sum of 3 terms. One involves the collective field coordinates and expresses the degree of excitation of organized oscillations. The others represent the kinetic energy of the electrons and the residual particle interaction, which is not describable in terms of the organized oscillations, and corresponds to a screened interparticle force of short range. Both a classical and a quantum-mechanical treatment are given, and the criteria for the validity of the collective description are discussed. (auth)

4463
THE PHOTOGRAPHIC ACTION OF SLOW ELECTRONS. C. Haigh and T. Smith. Proc. Leeds Phil. Lit. Soc. 5, 308-12(1950) Nov.

Using a magnetic spectrum method a new determination of the photographic law for slow electrons has been made. The blackening produced by electrons having less than 300 volts energy on greased Ilfex film is directly proportional to the electron beam intensity up to a photographic density of 1·5. At higher densities a law of the Swartzchild form is found to represent the results, both the contrast and sensitivity being greater than with previously examined films. (auth)

GASES

4464
A STATIONARY METHOD FOR MEASUREMENTS OF DIFFUSION COEFFICIENTS. Ludwig Waldmann. Z. Naturforsch. 5a, 327-30(1950) June. (In German)

As shown in a former paper (Z. Physik 124, 2(1947)), diffusion coefficients of gases can be deduced from observations of nonstationary diffusion thermoeffects. Since in practical work stationary measurements are often more convenient, a method using stationary effects is indicated here. In two laminar gas currents of different composition, which flow parallel to each other with mutual interdiffusion, the concentration difference decreases exponentially in the downstream direction. The temperature difference accompanying the diffusion, i.e., the stationary diffusion thermoeffect, follows the same law in its downstream decrease. From the amount of these decreases the diffusion coefficient can be derived if the current velocity is known. The

experimental realization of this method was worked out on the A/N_2 diffusion. Furthermore, using the (10% H_2, 90% N_2)/N_2 diffusion, a verification was made of a relation, described elsewhere (Z. Naturforsch. 5a, 322(1950)), between ordinary diffusion and thermodiffusion in Lorentz mixtures, i.e., gas mixtures containing many heavy and few light atoms. (auth)

4465

TRANSPORT PROPERTIES OF GASES WITH A SQUARE-WELL MOLECULAR INTERACTION POTENTIAL. Eugene M. Holleran and Hugh M. Hulburt. J. Chem. Phys. 19, 232-41(1951) Feb.

The kinetic theory cross-section integrals are calculated for the square-well molecular potential model. Parameters are determined for light gases from viscosity measurements and are used to reproduce viscosity data for pure gases and binary mixtures. Comparison is made between these parameters and those found from compressibility data and other transport properties. Different sets of parameters are apparently required for each transport property in order to account for the experimental results. The thermal diffusion constant for this model is a function of temperature and one other parameter. Excellent reproduction of the neon isotope data is obtained, and predictions of the qualitative behavior of the thermal diffusion ratio are made. (auth)

INSTRUMENTS

4466

RCA Labs. Div., Radio Corp. of America

ELECTRONIC DEVICES FOR NUCLEAR PHYSICS; THIRD QUARTERLY REPORT; JANUARY 1951–APRIL 1951. G. A. Morton, Director. [nd] 17p. (AECU-1350)

The experimental production of large cathode photomultiplier tubes suitable for such applications as γ-ray spectroscopy is discussed. Characteristics of two of these photomultiplier tubes are described. The circuit diagram is shown of a testing device used for making static measurements of the electron optical characteristics of photomultiplier tubes. Proposed design of a high gain photomultiplier for general scintillation work is discussed briefly. The design of a quantizing tube electron gun and its operation are described in detail. Measurements and circuitry which may be required for the proposed pulse height selector tube and system are discussed.

4467

Los Alamos Scientific Lab.

SCALAR MODEL SC-3. E. L. Kemp. July 1, 1950. 21p. (LA-1207)

The Model SC-3 is a binary scaler built on a 17- by 12- by 3-in. chassis. The first 8 pages of the report include a general description, operation procedure, and circuit description. Then follow 4 photographs, 6 diagrams, and a list of materials used.

4468

THE AMPLIFYING MECHANISM AND THE CALIBRATION OF AN ELECTROMETER TUBE WITH A SMALL TIME CONSTANT. Fritz Hawliczek. Sitzber. Akad. Wiss. Wien, Math.-naturw. Klasse, Abt. IIa 155, 371-91(1947). (In German)

The amplifying mechanism of circuits containing electrometer tubes with small time constants, used in measurements of ionizations produced by corpuscular radiations, has been investigated experimentally. In determining the amplification characteristics, capacities both of the tube anodes and of the adjoining circuit elements must be taken into account. Two methods of absolute charge calibration of the instrument are proposed.

4469

CORONA VOLTAGE REGULATOR TUBES FOR NUCLEONICS. D. L. Collins. Proc. Natl. Electronics Conference 6, 455-8(1950) Sept. 25-27.

The use of corona voltage regulators offers several advantages over other methods of regulation commonly used. These are illustrated in a discussion of tube characteristics, theory of operation, parameters, and applications. Typical circuits are presented for scintillation and proportional-counter applications, for both fixed and variable laboratory power supplies.

4470

AN ELECTROSTATIC FOCUSING SYSTEM AND ITS APPLICATION TO A FINE FOCUS X-RAY TUBE. W. Ehrenberg and W. E. Spear. Proc. Phys. Soc. (London) 64B, 67-75(1951) Jan.

The description is given of an electrostatic focusing system by which electrons emitted from the tip of a hairpin filament are reunited at a distance of 2 to 3 cm. No intermediate potentials are required. An x-ray method is used for the experimental investigation of its properties. The electron spot is a reduced image of the tip of the filament and has a diameter of about 40 μ. On the basis of this system, a fine focus x-ray tube is designed, with a peak specific target loading of about 11 kw/mm^2. Some performance data are given. (auth)

4471

AN IMPROVED DC AMPLIFIER FOR PORTABLE IONIZATION CHAMBER INSTRUMENTS. N. F. Moody. Rev. Sci. Instruments 22, 236-9(1951) Apr.

It is widely recognized that the zero stability of d-c amplifiers for measuring currents in the $\mu\mu$a region can be enhanced by the application of negative feedback. The promised advantages are often not fulfilled, however, and a design approach which emphasizes the economic exchange of amplifier gain for these benefits is outlined. In portable battery-operated ionization chamber instruments, which are the main concern of this paper, it is not easy to achieve the loop gain needed for optimum performance, and a subsidary reflexing scheme is adopted to overcome the limitation. In conclusion, a practical instrument incorporating this improved circuit receives brief discussion, and performance figures are given. (auth)

4472

A PHASE-SENSITIVE DETECTOR CIRCUIT HAVING HIGH BALANCE STABILITY. N. A. Schuster. Rev. Sci. Instruments 22, 254-5(1951) Apr.

A new phase-sensitive detector circuit has been developed having unusually high balance stability. Its inherently fixed balance should make it useful in the many types of servo circuits which utilize phase-detected error signals. It has been found to be particularly useful in nuclear resonance measuring circuits. (auth)

4473

AN X-RAY MICRO-BEAM TECHNIQUE: II—A HIGH INTENSITY X-RAY GENERATOR. P. Gay, P. B. Hirsch, J. S. Thorp, and J. N. Kellar. Proc. Phys. Soc. (London) 64B, 374-86(1951) May.

A high-intensity x-ray generator has been constructed which combines the use of small foci and a rotating anode. Improvements in target loading per unit area of about 50 times compared with ordinary stationary target tubes have been obtained. Any width of focus between about 1 mm and 50 μ can be produced by means of an adjustable, biased electron gun. A detailed experimental investigation of the focusing properties of the high voltage gun has been made; the conditions for obtaining small foci and maximum current are derived. The magnitude of the negative bias is

found to be the most important factor controlling the focusing action of the electron gun. The effect of bias on focal structure is discussed for several types of filament and is explained on the basis of suppression of emission from different parts of the filaments. (auth)

ISOTOPES

4474

Oak Ridge National Lab., Y-12 Area

LITERATURE SURVEY OF LITHIUM NATURAL ABUNDANCE RATIOS. Russell Baldock and Joe R. Patton. May 16, 1951. 25p. (Y-758)

Unusually large variations in the reported natural abundance of Li isotopes led to a survey of 36 publications. Optical and mass spectrographic determinations show fairly consistently different results. The annotated bibliography makes it evident that the problem has been extensively investigated, but no satisfactory explanation for the disagreement between the workers in the field was found.

4475

CARBONATE-WATER ISOTOPIC TEMPERATURE SCALE. Samuel Epstein, Ralph Buchsbaum, Heinz Lowenstam, and Harold C. Urey. Bull. Geol. Soc. Am. 62, 417-25(1951) Apr.

A relationship between temperature and relative O^{18} abundance in calcium carbonate in marine shells has been determined. If the relative O^{18} abundance of the water in which the shell grew is known, the temperature can be determined to an accuracy of ±1.0°C. The relative O^{18} contents of marine waters increase with salinity and, in the case of surface marine waters, with salinity and temperature. (auth)

4476

A GRAPHICAL REPRESENTATION OF THE SYSTEMATICS OF STABLE ATOMIC NUCLEI. F. L. Breusch. Rev. faculté sci. univ. Istanbul 12, 1-37(1947) Jan. (In German)

A diagram of stable isotopes is proposed, in which the abscissas are atomic numbers, and the ordinates, inclined at 45°, are the neutron surpluses. The various periodicities in the properties of elements are reflected in the maxima and minima of the diagram. Mattauch's rule of isobars and Breusch's rule of chief isotopes are graphically derived. Another graphical procedure furnishes curves of isotope abundances, which are bell-shaped in the Gaussian manner.

4477

THE ISOTOPIC ABUNDANCE RATIO OF CARBON IN METEORITES; trans. from Doklady Akad. Nauk S.S.S.R. 72, 663-6(1950). A. V. Trofimov. 1950. 8p. (NP-2301)

An abstract from the original Russian article appeared in Nuclear Science Abstracts as NSA 4-6393.

ISOTOPE SEPARATION

4478

SEPARATION OF ISOTOPES. W. Groth. Umschau 50, 402-4(1950) July 1. (In German)

In a concise outline of various known methods of isotope separations, it is stated that in the electrolytic enrichment of heavy water used by the Germans during the last war the yield was notably increased by the introduction of an exchange reaction between the liberated hydrogen and water vapor; the reaction took place in the presence of a catalyst and resulted in the enrichment of water vapor in D, after which the water was added to that of the electrolytic cell. Mention is made of several methods now in experimental or development stages, such as those utilizing differences in chemical-dynamical constants of reactions, those employing biochemical reactions (ferments), desorption procedures, processes in glow-discharge tubes, diffusion in solids, and others.

MASS SPECTROGRAPHY

4479

ON THE APPLICATION OF A PHILIPS IONIZATION GAUGE TYPE OF ION SOURCE IN A MASS SPECTROMETER LEAK DETECTOR. N. Warmoltz. Applied Sci. Research (Netherlands) 2B, No. 1, 61-5(1951)

The development of mass spectrometer leak detectors is sketched, and then attention is called to the possibility of obtaining a sharp focus by using the Philips ionization-gauge type of source in combination with a homogeneous electric field perpendicular to a homogeneous magnetic field. In these fields, ions injected at the same point describe paths, the projections of which on a plane perpendicular to the magnetic field are cycloids. The form of these paths is such that the particles are focused on certain lines perpendicular to the magnetic field, independently of their initial velocity and the angle of entrance in the fields Some mass spectrometers (called trochotrons) have already been made according to this principle.

MATHEMATICS

4480

Kenyon Coll.

CRITERIA FOR THE CONTINUITY OF A LINEAR FUNCTIONAL IN THE REAL HILBERT SPACE AND IN SOME MORE GENERAL SPACES. Otton Martin Nikodym. [nd] 17p. (AECU-1377)

Proof is given of the following criterion for the continuity of linear functionals in the real Hilbert space, which may be neither separable nor complete: a linear functional f(x) is continuous if and only if there exists at least one open not empty set on which f(x) does not admit all real values. This is not a characteristic property of the Hilbert space; it holds even in spaces more general than the linear topological spaces, and the author's aim was obtained by studying linear spaces which are topologized in a very general way. For general spaces some other criteria are obtained, and, as a side result, a generalization of the known theorem of J. P. LaSalle on the existence of non-trivial linear functionals (Duke Math. J. 8(1941)) in linear topological spaces is proved. Moore-Smith convergence is used as a tool.

MEASURING INSTRUMENTS AND TECHNIQUES

4481

Radiation Lab., Univ. of California

THE MEASUREMENT OF LOW MAGNETIC FIELDS USING PARAMAGNETIC RESONANCE. E. C. Levinthal and E. H. Rogers. Apr. 6, 1951. 41p. (UCRL-1239)

An account is given of the experimental and theoretical results obtained during an investigation of the feasibility of measuring magnetic fields from 5 to 50 gauss with an accuracy of ±0.02 gauss using a sample no larger than 1 cc in volume in the presence of field inhomogeneities ranging between 1 and 3 gauss/in. The conclusion reached is that the field measuring requirements outlined can be met in several ways using paramagnetic media presently available. (auth)

4482

A CLOUD-IONIZATION CHAMBER FOR THE STUDY OF COSMIC-RAY NUCLEAR INTERACTIONS. H. W. Lewis, W. W. Brown, D. O. Seevers, and E. W. Hones. Rev. Sci. Instruments 22, 259-63(1951) Apr.

A combination cloud chamber and ionization chamber in which the gas (argon at 51 lb/in.^{2} saturated with iso-amyl

alcohol) is common to both chambers is described. The ion chamber, a 3¾-in. diam brass cylinder 8 in. in length, open at both ends, and having 1/16-in. central wire, is mounted coaxially with the cloud chamber, which has a useful rectangular volume 10 by 10 by 8 in. A burst occurring in the ion chamber generates a pulse which is used to trigger the expansion mechanism. Rapid reduction of the cylinder voltage from −1800 volts to ground, after electron collection is over, prohibits any appreciable motion of positive ions and thus permits observation of the tracks of the burst producing particles. In preliminary tests at sea level, cosmic ray bursts from cascade showers and from stars occurring in the wall (up to 10 prongs) and in the gas (up to 5 prongs) of the ion chamber have been observed. (auth)

4483

Department of Mines and Technical Surveys Mines Branch, Ottawa (Canada)

COINCIDENCE CIRCUIT FOR SCINTILLATION COUNTERS (Topical Report No. TR-85/51). J. E. Wilson. June 25, 1951. 12p. (NP-3214)

A coincidence circuit has been designed with the purpose of recording only the simultaneous arrival of pulses from two scintillation counters so placed that radiation particles from a sample will pass through both counters while background particles will be unlikely to pass through both counters. The background counting rate received in this way, known as the random coincidence rate, is very much less than the background rate from either counter alone. The coincidence circuit was designed to be sensitive to pulses with a rise-time of the order of 1 μsec, to have a resolving time not greater than 1 μsec, and to be able to function at counting rates (sample + background) up to 10,000 per second.

4484

Palmer Physical Lab. and Naval Ordnance Lab., Princeton Univ.

A CYLINDRICAL CLOUD-ION CHAMBER; COSMIC RAY GROUP (Technical Report No. 5). Brown, Rau, and Reynolds. June 14, 1951. 19p. (NP-3209)

A detailed description is given of the design and operation of a cloud-ion chamber consisting of a cloud chamber of conventional cylindrical design about an internal ior chamber of cylindrical geometry. Pulses from this internal ion chamber are used to trigger the cloud chamber and cameras. Pulse height and shape associated with each event are obtained by photography of an oscilloscope screen.

4485

DELAYED COINCIDENCE CIRCUIT FOR SCINTILLATION COUNTERS. Arne Lundby. Rev. Sci. Instruments 22, 324-7(1951) May.

Using organic crystals or liquids as scintillators and 1P21 photomultipliers as detectors, a delayed coincidence circuit has been designed for measuring nuclear lifetimes in the region 10^{-10} to 10^{-7} sec. The pulses from the photomultipliers were amplified in distributed amplifiers and applied to a Ge diode bridge coincidence circuit. The apparatus has been used for measuring scintillation decay times, the lifetimes of nuclear transitions, and the time of flight of light over distances of the order of one meter. (auth)

4486

DESIGN CHARACTERISTICS OF AIR PROPORTIONAL COUNTERS. A. C. Sheckler. Proc. Natl. Electronics Conference 6, 527-32(1950) Sept. 25-27. (See also NSA 5-1615)

An investigation of the effect of dimensional changes upon the characteristics of air proportional counters is described. The investigation is based on observations of results and on basic studies, such as the study of flux distribution due to the high voltages imposed upon a proportional counter.

4487

FURTHER STUDIES — EXPERIMENTAL AND THEORETICAL — OF A WIDE-ANGLE β-SPECTROMETER WHICH USES A PROLATE SPHEROIDAL MAGNETIC FIELD. T. H. Braid and H. O. W. Richardson. Proc. Phys. Soc. (London) 64A, 163-74(1951) Feb.

A β spectrometer is described which focuses a conical sheaf of rays emitted at about 80° to the axis of a prolate spheroidal magnetic field. In agreement with a previous theoretical prediction, the trajectories cross over at two sites in the rotating meridional plane. The field behaves in some ways like a magnetic mirror and can be arranged to form an aberration-free image of a point on the axis of symmetry. It cannot, however, give a clear image of an area because the Abbe sine condition is not fulfilled. The wide-angle focusing action is compared with that recently found by Slatis and Siegbahn (Arkiv Fysik 1, No. 17, 339 (1949)) for which a different optical analogue is suggested, based on the isolation of a meridional focal line between two refractions. The adjustment of the spectrometer and measurements of its resolving power and solid angle of collection are described, an example being 1.4% of 4π with a line-width of 1/133 at half-height. By working at less than unit magnification it is possible to focus rays emitted at less than 80° to the axis. (auth)

4488

AN INTEGRATING X-RAY DOSEMETER, READING DIRECTLY IN SKIN DOSE. R. Oliver. J. Sci. Instruments 28, 97-9(1951) Apr.

This instrument includes an ionization chamber covering the whole x-ray beam in the master cone of the set, a cathode-follower circuit mounted on the cone, and a trigger unit (near the control panel) based on a cold cathode relay valve. The use of special high-insulation relays and electrometer valves is avoided. The indicator steps are made to represent 5 r skin dose for any treatment condition by the use of variable bias (calibrated directly in terms of, for example, applicator field size) on the trigger circuit. The calibration remains constant within 2% over a period of months and is sensibly independent of mains voltage variations. (auth)

4489

AN INVESTIGATION OF A SCINTILLATION COUNTER USING ANTHRACENE CRYSTALS. B. Ross. Proc. Natl. Electronics Conference 6, 533-42(1950) Sept. 25-27.

A quantity of anthracene was purified by a process based upon P. R. Bell's method. Crystals as large as 4.2 × 1.9 cm were grown from Reilly's Scintillation Grade Anthracene, and the material was purified by the author. A quantity of anthracene crystals was obtained from Harshaw Chemical Co. A comparison of the gamma efficiencies of these crystals was made in a scintillation counter using a type RCA 5819 photomultiplier.

4490

IONIZATION CHAMBERS FOR ELECTRON DOSIMETRY. J. W. Boag, F. D. Pilling, and T. Wilson. Brit. J. Radiology 24, 341-4(1951) June.

Ionization chambers are described for use in the collimated electron beam from an electrostatic generator. Such a chamber must be relatively transparent to electrons and can be placed in the direct beam above the experimental material or immediately in front of the window through which the electron beam emerges. Al foil 0.001 in. thick is used for the walls and the three diaphragms. Accurate definition of the volume ionized is achieved by defining the

electron beam immediately above the ionization chamber by means of an Al "stop." Sectional views of three such chambers are diagramed. The spacing of the electrodes must be chosen so as to permit saturation to be reached or closely approached. An equation is given for computing the distance for any given ionization intensity.

4491

MEASUREMENT OF BETA SPECTRA. N. F. Verster. Nederland. Tijdschr. Natuurk. 17, 119-29(1951) Apr. (In Dutch)

A general outline of methods for the determination of β spectra is given. 17 references.

4492

ON THE DETERMINATION OF EFFECTIVE CROSS SECTIONS FOR THERMAL NEUTRONS. Georges Güeben. Bull. soc. roy. sci. Liege 19, 456-68(1950) Nov. (In French)

An experimental setup for measuring cross sections for thermal-neutron captures is described. It consists of a paraffin block containing a Ra + Be source, the tested sample, and a detector. Ag, dysprosium oxide, Rh, In, and Mn are used as detectors. Corrections for the geometry of the instrument are discussed. Results of experiments on various absorbers will be given later.

4493

ON SPHERICAL SETUPS USED FOR THE DETERMINATION OF CROSS SECTIONS FOR FAST-NEUTRON PHENOMENA. K. Lintner, H. Moser, and J. Cerny. Sitzber. Österr. Akad. Wiss., Math.-naturw. Klasse, Abt. IIa 158, 123-34(1950). (In German)

In instruments in which cross sections for processes involving fast neutrons are measured with the aid of spherical samples surrounding the source, an interfering reabsorption of neutrons by the sample takes place after the neutrons have been slowed down in an outer shell of a H-containing substance. This can be corrected with the aid of two procedures described.

4494

Commonwealth X-Ray and Radium Lab. (Australia)

PREPARATION OF FILTERED SAMPLES FOR RADIOACTIVE ASSAY (Tracer Elements Report No. 1; Australian Technical Paper No. 2109). T. H. Oddie and K. R. Lynn. Feb. 1951. 9p. (NP-3110)

General practical rules are given for preparing concentrated radioactive material as a precipitate for counting under an end-window Geiger counter and for calculating self-absorption corrections and the sample thickness needed for best results.

4495

THE PROBLEM OF USING SCINTILLATION CRYSTALS AS PROPORTIONAL COUNTERS FOR HIGH ENERGY PARTICLES. Francis X. Roser and Theodore Bowen. Phys. Rev. 82, 284-5(1951) Apr. 15.

Experiments have been performed to determine whether close proportionality between the energy of incident particles and light output in scintillation counters still holds for high energy μ mesons and whether the energy loss of these particles in the crystal would fit the theoretical formula of Bethe and Bloch. Results indicate that proportionality between energy and pulse height within a limit of less than 5% seems to be strongly indicated for μ mesons up to 170 Mev. The energy loss can be satisfactorily explained on the basis of the Bethe-Bloch formula as corrected by Wick.

4496

Naval Ordnance Lab. and Palmer Physical Lab., Princeton Univ.

REAR ILLUMINATED CLOUD CHAMBER; COSMIC RAY GROUP (Technical Report No. 4). R. Ronald Rau. June 20, 1951. 21p. (NP-3211)

A cloud chamber designed to be sent to very high altitudes by free balloons in order to investigate the primary cosmic radiation is described in detail. The design features considerations of weight, size, and simplicity. These chambers were used on several successful flights and obtained pictures of the cosmic radiation at 90,000 to 100,000 ft. The general feature of special interest is perhaps the fact that these chambers were illuminated from the rear instead of the side. The scattering of light from the droplets is thus small angle scattering, and consequently the necessary intensity of illumination is considerably reduced. (auth)

4497

RESPONSE OF AN ANTHRACENE SCINTILLATION COUNTER TO PROTONS. H. B. Frey, W. M. Grim, W. M. Preston, and T. S. Gray. Phys. Rev. 82, 372-3 (1951) May 1.

The proton response of an anthracene scintillation counter below 3.7 Mev has been measured. When combined with previously published data up to 17 Mev, a smooth curve results. An attempt was made to correlate the efficiency of the light output with the ion density by plotting the differential light output as a function of the differential energy absorption for both electrons and protons. The available information is not sufficiently extensive or accurate to determine whether or not the proton and electron data coincide. (auth)

4498

SCINTILLATIONS IN SOME PHOSPHOR-PLASTIC SYSTEMS. W. S. Koski. Phys. Rev. 82, 230-2(1951) Apr. 15.

The scintillation properties of anthracene and stilbene dissolved in polystyrene, Lucite, and Paraplex have been investigated. The Lucite and Paraplex solutions were very poor counters, but the polystyrene solutions compared favorably in performance with pure anthracene. A study of the emission spectra indicates that the fluorescence bands of polystyrene overlap the absorption bands of anthracene and stilbene; consequently, it is possible to have an efficient energy transfer from the plastic to the phosphor in these cases and good counting systems result. This is not the case in the systems involving Lucite and Paraplex; consequently, their performance as counters is poor. (auth)

4499

Naval Research Lab.

A SURVEY OF THE THEORETICAL ASPECTS OF THE LUMINESCENCE OF INORGANIC CRYSTALLINE SOLIDS. L. R. Furlong. July 28, 1950. 36p. (NRL-3717)

The survey gives a brief discussion of the quantum-mechanical method of attacking a problem in the theory of the solid state and two methods of approximation leading to the normal and excited electronic states in crystals. This is followed by a treatment of two representations for the mechanism of luminescence in which the functions of crystal states, impurity states, and trapping states are discussed. A general discussion is given of the types of energy levels resulting from the introduction of impurities into crystals, the penetration of the crystal by the impurity, the optimum impurity concentration, and the effect of temperature variation on the spectral distribution of phosphors. There is a description of the crystal flotation method of determining the lattice constant and a discussion of the coordination hypothesis concerning multiple emission bands in certain types of phosphors. The nature of electron traps and the role which they play in the delayed emission of phosphors is discussed. This is followed by derivations of the types of decay for traps of various depths and distributions, and the retrapping of electrons for the case of traps of a single depth is considered. A section on efficiency includes a general definition of luminescent efficiency and

the Klasens theory of positive hole migration and efficiency. 14 references.

4500
A TRIGGERING DEVICE FOR ARC DISCHARGE LAMPS USED IN CLOUD CHAMBER PHOTOGRAPHY. Ranjit Kumar Das. Indian J. Phys. 24, 497-500(1950) Nov.

A new triggering circuit designed for the specific purpose of cloud chamber photography is described. In addition to its normal function as a trigger, it effectively controls the requisite time delay between the passage of a cosmic ray particle and its subsequent illumination for photography. (auth)

4501
Naval Research Lab.
UPPER ATMOSPHERE RESEARCH REPORT XII; DIRECT MEASUREMENTS OF SOLAR EXTREME ULTRAVIOLET AND X-RAYS FROM ROCKETS BY MEANS OF A $CaSO_4$: Mn PhOSPHOR. K. Watanabe, J. D. Purcell, and R. Tousey. Sept. 18, 1950. 54p. (NRL-3733)

Measurements of extreme ultraviolet and x rays from the sun were made from V-2 rockets by means of a $CaSO_4$: Mn thermoluminescent phosphor. Data from four rocket firings show the presence in sunlight at high altitudes of extreme ultraviolet radiation of wavelengths less than 1300 A and of soft x rays. The properties of the phosphor show it to be unique in having no sensitivity to wavelengths longer than 1300 A together with excellent sensitivity to the extreme ultraviolet, x rays, and γ rays. These characteristics make it possible to measure the short-wavelength radiations present in sunlight at high altitudes in the earth's atmosphere by exposing samples of the phosphor to total sunlight. (auth)

MESONS

4502
Radiation Lab., Univ. of California
SCATTERING OF π^+ MESONS BY CARBON. (abstract) M. Skinner and C. Richman. Feb. 27, 1951. 1p. (UCRL-1146)

The report is reproduced here in its entirety.

A C target 2.7 cm thick was placed in the 54-Mev π^+-meson beam (Richman, Skinner, Merritt, and Youtz, Phys. Rev. 80, 900(1950)) of the Berkeley 184-in. synchrocyclotron. Mesons scattered from the C at 90° were detected in nuclear emulsions embedded in Cu absorbers. To obtain a reasonable ratio of meson to background tracks in the emulsions it was necessary to sacrifice good angular and energy resolution. Some mesons were accepted that scattered at angles as low as 60° or as high as 130°. The energy spectrum of the scattered mesons after leaving the C target is continuous from zero Mev to the maximum meson energy. By integrating the spectrum one obtains a value for the differential scattering cross section. (This value is somewhat lower than the true differential cross section, since at any point in the C target there is a mimimum energy which a meson must have after scattering in order to leave the C.) On the basis of 50 scattered mesons, this differential cross section for the scattering of 47-Mev π^+ mesons at 90° from C is $(2.2 \pm 1.0) \times 10^{-28}$ cm^2 steradian.

4503
Radiation Lab., Univ. of California
THE POSITRON SPECTRUM FROM μ MESONS. (abstract) Harmon W. Hubbard. Apr. 1951. 1p. (UCRL-1259)

The report is reproduced here in its entirety.

The electrostatically deflected proton beam from the 184-in. Berkeley cyclotron was used to produce a π^+ meson beam (Richman, Skinner, Merritt, and Youtz, Phys. Rev. 80, 800(1950)). The beam is brought outside the "cove" shielding through a port by means of an electromagnet. A cloud chamber in a magnet producing a field of 8000 gauss is placed in the beam. Some of the mesons stop in carbon plates situated in the cloud chamber. The decay positrons, to which the stopped π^+ mesons give rise, are subjected to measurement. Examination of the tracks, which is now in progress, indicates the spectrum to have a maximum at about 35 Mev. A careful study is being made of the shape of the spectrum near the maximum positron energy, in view of its theoretical importance (Tiomno and Wheeler, Revs. Modern Phys. 21, 144(1949)).

4504
Radiation Lab., Univ. of California
π^- ABSORPTION IN D_2 AND THE N-N FORCE. R. Lee Aamodt, Wolfgang K. H. Panofsky, and R. Phillips. June 21, 1951. 7p. (UCRL-1373)

Watson and Stuart (Phys. Rev. 82, 738(1951)) have recently published detailed theoretical calculations concerning the γ-ray spectrum from the process $\pi^- + D \rightarrow 2n + \gamma$ previously observed (Panofsky, Aamodt, and Hadley, Phys. Rev. 81, 565(1951)). The experimental status concerning this spectrum is discussed. When the curves of Watson and Stuart are "folded" into the resolving power of the pair spectrometer used in the absorption experiments the resultant curves for various values of the n-n interaction show a negligible difference in shape but are effectively displaced along the energy scale. A plot is shown of this effective displacement of theoretically computed spectra resulting from the process $\pi^- + D \rightarrow 2n + \gamma$ as a function of the binding energy of the lowest level of n-n system. A second plot shows the theoretical γ spectra, with the resolution folded in, of the processes $\pi^- + D \rightarrow 2n + \gamma$ and $\pi^- + H \rightarrow n + \gamma$. Experimental data on the processes $\pi^- + D \rightarrow 2n + \gamma$ and $\pi^- + H \rightarrow n + \gamma$ are also plotted.

4505
Radiation Lab., Univ. of Calif.
ON THE ANGULAR DISTRIBUTION OF THE π^+ MESONS FROM 341-MEV PROTONS ON PROTONS. Marian N. Whitehead and Chaim Richman. June 29, 1951. 5p. (UCRL-1377)

In order to further determine the angular distribution of π^+ mesons from 341-Mev protons on protons, the meson yield has been measured at 60°. The obtained spectrum shows the characteristic peak to be around 25 Mev. From the experimental observations and calculations it is suggested that the total meson spectrum from the reaction $P + P \rightarrow D + \pi^+$ is approximately in a P-wave.

4506
THE COUPLING OF A DIRAC FIELD TO A KEMMER FIELD. Abraham Klein. Phys. Rev. 82, 639-46(1951) June 1.

A method is given whereby a Dirac field can be so coupled to a Kemmer field as to reproduce any of the invariant coupling terms "permitted" in the usual wave formulation of meson theory. This is done independently of any statement of connection of the Kemmer wave function with the wave functions of the wave formulation. A special reducible representation of the Kemmer matrices is employed which permits the theory to be developed along lines closely analogous to the Dirac theory. As a single illustration of the utility of the theory, the nuclear forces are calculated to lowest nonvanishing order. (auth)

4507
DARLING'S THEORY AND THE MASS OF THE π MESON. P. R. Zilsel. Phys. Rev. 82, 557(1951) May 15. (Letter to the editor)

It is suggested that Darling's generalization (Phys. Rev. 80, 460(1950)) of the Dirac equation for a free electron may be the correct equation for the family of particles having the spin character of the charged π meson. One root of the equation is very close to the experimental value of the charged π-meson mass (275 ± 2 m). The theory would predict the existence of a π-type meson of mass ≃132 m.

4508
ENERGY SPECTRUM OF THE ELECTRONS FROM μ^+ MESON DECAY. Ryokichi Sagane, William L. Gardner, and Harmon W. Hubbard. Phys. Rev. 82, 557-8(1951) May 15. (Letter to the editor)

An attempt to measure the energy spectrum of decay electrons of μ mesons is being made with the use of artificial mesons produced by the proton beam from the 184-in. cyclotron at University of California. The experimental setup using a spiral orbit spectrometer is shown schematically. Results indicate close similarity to the theoretical predictions of Tiomno, Wheeler, and Rau (Revs. Modern Phys. 21, 144(1949)) and may be summarized in 3 major points: (1) $E_{max} = 53 \pm 2$ Mev, from which $m_\mu = 212 \pm 5\ m_e$ with the assumptions $\mu^+ \rightarrow e^+ + 2\nu$ where $m_\nu \cong 0$. (2) Intensity maximum at $p = 70\ mc \pm 3$ on a momentum scale. (3) Intensity

4509
Atomic Energy Research Establishment, Harwell, Berks. (England)
EXPERIMENTS ON THE CAPTURE OF NEGATIVE μ MESONS. R. Batchelor. Apr. 4, 1951. 20p. (AERE-N/R-682)

Experiments have been carried out to measure the mean lives of negative μ mesons in materials of low atomic number by detecting any neutrons emitted after capture. No conclusions could, however, be made on this capture process since the bremsstrahlung produced by the decay electrons in their passage through the absorber gave a larger counting rate than the neutron rate looked for. The results, however, have been used to add weight to the conclusions of Hinks and Pontecorvo that the μ meson decays by the process $\mu \rightarrow e + 2\nu$. (auth)

4510
FURTHER MEASUREMENTS OF THE CHARGE RATIO OF μ MESONS AT SEA LEVEL. B. G. Owen and J. G. Wilson. Proc. Phys. Soc. (London) 64A, 417-24(1951) Apr.

Extended measurements of the charge ratio (positive/negative) of near-vertical μ mesons at sea level show that it increases with meson momentum from about 1.17 at 10^3 Mev/c up to about 1.26 at 4×10^3 Mev/c. At higher momenta the statistical accuracy of the measured charge ratio is limited by the instrumental rate of collection, and it cannot yet be definitely decided whether the charge ratio decreases with increasing momentum, although the evidence now available favors a slow decrease. The general implications of the form of variation of charge ratio with momentum are indicated. (auth)

4511
Microwave Lab., Stanford Univ.
NONLINEAR MESON THEORY OF NUCLEAR FORCES; I. NEUTRAL SCALAR MESONS WITH POINT-CONTACT REPULSION; II. NONLINEARITY IN THE MESON-NUCLEON COUPLING. L. I. Schiff. June 1951. 47p. (ML-144)

The first paper develops an attempt to account for nuclear saturation and shell structure in terms of many-body forces that are derived from mesons that obey a nonlinear wave equation. Classical field theory is used, and in some cases the practical difficulties of obtaining numerical answers are reduced by employing a variation method. Apart from a cutoff, which appears in this particular form of the theory but could be eliminated, there are two parameters in the theory; they can be chosen so that nuclear matter has a stable density equal to the observed value and a variational binding energy equal to 42% of the observed value, thus approximately accounting for saturation. The two-nucleon interaction has the observed order of magnitude in empty space and is greatly reduced within nuclei.

In the second paper the possibility of accounting for nuclear saturation by means of classical neutral scalar mesons that are coupled nonlinearly to the nucleons is investigated. It is shown that the interaction energy of an aggregate of nucleons is the same as in the usual linear theory if the nucleons are regarded as point sources. The theory does not, therefore, lead to saturation. (auth).

MOLECULAR STRUCTURE

4512
THE STRUCTURE OF AMMONIUM CHLORIDE BY NEUTRON DIFFRACTION. G. H. Goldschmidt and D. G. Hurst. Phys. Rev. 83, 88-94(1951) July 1.

From the intensities of powder diffraction lines the positions of the deuterons in ND_4Cl have been determined at liquid nitrogen and room temperatures. The experimental results confirm at low temperature the space group T_d^1 and the tetrahedral structure of the ammonium ion with an N−D separation 1.03A. At room temperature the T_d^1 space group persists. Neither free rotation nor disordered orientations of the ammonium ions have been observed. Details concerning deuteron vibrations are discussed. (auth)

NEUTRONS

4513
Los Alamos Scientific Lab.
NOTE ON CENSUS-TAKING IN MONTE-CARLO CALCULATIONS. E. Fermi and R. D. Richtmyer. July 11, 1948. Decl. May 22, 1951. 7p. (AECD-3164; LADC-946)

An analysis is given of the proposal that in some Monte Carlo problems census taking should be made on the basis of distance traveled rather than time elapsed. The analysis given is restricted to critical systems, and it is shown how to interpret the resulting neutron distribution in this case. (auth)

4514
Oak Ridge National Lab.
PRELIMINARY RESULTS ON THE DETERMINATION OF THERMAL NEUTRON FLUX IN WATER. E. D. Klema and R. H. Ritchie. Apr. 24, 1951. Decl. May 29, 1951. 3p. (AECD-3174; CF-51-4-103)

The determination of thermal neutron flux in water by the foil method requires that the flux be accurately known at various positions in the standard graphite pile in order that foils may be calibrated. It requires in addition that the difference in flux perturbation by a foil in graphite and in water be known. To take account of the difference in flux perturbation, a series of In foils of various thicknesses was exposed in the graphite pile at 115 cm from a 1-g Ra-Be source and in the water pile at the Bulk Shielding Facility at 20 cm from a 0.5-g Ra-Be source. It was found that $(Nv)_{water} = C A_{water} (Nv)_{graphite}/A_{graphite}$ where A is the measured activity (counts per unit time) of the foil and C takes on different values at different thicknesses as obtained from a smooth curve drawn through the experimental points.

4515
Columbia Univ.
INTERACTION OF NEUTRONS WITH ELECTRONS IN LIQUID BISMUTH. (abstract) W. W. Havens, Jr., L. J. Rainwater, and I. I. Rabi. [nd] 1p. (CUD-89; DR-1623)

The report is reproduced here in its entirety.

The neutron electron interaction has been determined by measuring the cross section of liquid Bi as a function of neutron wavelength. This cross section decreases by 3% between 0.33 and 1.33 A. The change in cross section is caused by (a) neutron capture, (b) liquid scattering, (c) relative velocity effect, and (d) neutron electron interaction. The spin dependent scattering is small because the total cross section of solid Bi is less than 0.5 barn at 5.5 A. The capture cross section of this Bi is 0.035 barn at 0.026 ev, determined by the pile oscillator. The relative velocity correction is 0.011 λ^2. The liquid effect was investigated by Placzek, Nyboer, and Van Hove, who proved that the type of structure did not alter the liquid effect a great deal. The liquid correction used was 0.095 λ^2. After applying these corrections the residual change was attributed to the neutron electron interaction. The neutron electron cross section can be expressed in terms of the Born approximation by giving an interaction potential V acting over a volume τ. Assuming τ a spherical volume of radius 2.8×10^{-13} cm, V is (5800 ± 1000) ev. An uncertainty of 650 ev is due to statistical consideration, the additional uncertainty being due to the uncertainty in the corrections applied. (See also AECD-2415, NSA 2-523)

4516

Oak Ridge National Lab.

NEUTRON ELECTRIC DIPOLE MOMENT, sect. 8 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. James H. Smith. Mar. 15, 1951. 1p. (ORNL-940(sect. 8))

The upper limit on the effective charge separation (neutron moment divided by electron charge) of the neutron has been reduced to 3×10^{-19} cm by recent results. (auth)

4517

INTERPRETATION OF PHOTONEUTRON YIELDS. A. G. W. Cameron. Phys. Rev. 82, 272-3(1951) Apr. 15. (Letter to the editor)

"Resonance" cross-section curves for several (γ,n) reactions are so similar in relative shape that their average cross-section shape has been used in an analysis of the photoneutron yields of 53 elements. The ratio of the yield at 18 Mev to that at 22 Mev is plotted against atomic number, and the peak cross section (or integrated cross section by a simple relationship) is also plotted against atomic number.

4518

Atomic Energy Research Establishment, Harwell, Berks. (England)

THE GENERAL PROPERTIES OF THE TRANSPORT EQUATION AND ITS USE IN DETERMINING THE MULTIPLICATION IN BODIES HAVING SPHERICAL SYMMETRY. A. H. Wilson. Dec. 1950. 35p. (AERE-MS-105A)

The author presents a study of neutron multiplication, in infinite homogeneous media and sundry spherically symmetrical systems, based on the properties of the relevant transport equation. In particular, equations giving the critical radii and time constants of spherically symmetrical systems with homogeneous cores embedded in either finite or infinite homogeneous tampers are derived for the isotropic scattering one-velocity model under the assumptions that the net outward flux of neutrons is everywhere continuous and that the flux of radially incoming neutrons is everywhere continuous (with, in particular, the value zero at the outer boundary—if any—of the system considered). The numerical results for certain configurations are compared with the corresponding results obtained by other methods. (auth)

4519

NEUTRON SOURCES. N. A. Vlasov. Uspekhi Fiz. Nauk 43, 169-253(1951) Feb. (In Russian)

A detailed review of works on sources of neutrons is given (86 references). A general outline of the subject is followed by a study of reactions (α,n) and (d,n), of disintegrations of high-energy deuterons, of reactions (p,n) and (γ,n), and of the generation of neutrons in the pile.

4520

PHOTONEUTRON CROSS SECTIONS OF Fe^{54}, Ni^{58}, AND Zn^{64}. L. Katz, H. E. Johns, R. G. Baker, R. N. H. Haslam, and R. A. Douglas. Phys. Rev. 82, 271-2(1951) Apr. 15. (Letter to the editor)

Photoneutron cross-section data for Fe^{54}, Ni^{58}, and Zn^{64} are tabulated and cross section versus energy curves are drawn, using the results of an earlier investigation by the authors (Phys. Rev. 80, 1062(1950)). A summary of photoneutron cross-section data of 15 other reactions is tabulated.

NUCLEAR PHYSICS

4521

Radiation Lab., Univ. of California

SUMMARY OF THE RESEARCH PROGRESS MEETING OF MARCH 8, 1951. Bonnie E. Cushman. June 27, 1951. 13p. (UCRL-1206)

A number of neutron deficient isotopes, after bombarding Nb^{93} with protons, have been obtained through spallation reactions. The decay of one of these, Zr^{87}, was followed radiochemically with a β-ray spectrometer, and complete results are given in UCRL-1064. The cross section of meson production by bombardment of deuterium photons from the synchrotron has been studied. The differential cross section of π^+ mesons was calculated. The factors measured were number of photons or equivalent quanta, the density of the particles in the beam, the counting rates from crystals and plates, and the geometrical factors. Details of the results and the various detection methods will be found in UCRL-1319. The total cross section was calculated roughly (without the benefit of data for 45°) to be 9×10^{-29} and 7×10^{-29} for H_2 and D_2, respectively. Similar experiments obtaining photomesons from He were conducted. A graph of the electronics involved is given, with a plate showing the distributed circuits. A summary of the results is added (complete report UCRL-1317).

4522

D. I. MENDELEEV'S VIEWS ON THE INEVITABILITY OF MASS CHANGES DURING TRANSMUTATIONS OF ELEMENTS. S. Z. Roginskiĭ. Uspekhi Khim. 20, 270-2(1951) May-June. (In Russian)

It is pointed out that in a paper, "The Periodical Regularity in Chemical Elements," published in 1872 (Ann. Chem. u. Pharm., Suppl. 8, No. 2, 133-229), Mendeleev explained the fractional differences between atomic masses as due to losses of mass accompanying the formation of heavy atoms from lighter ones and expressed the opinion that mass should be considered as a form of energy. The first formulation of these ideas is currently ascribed to Crookes (address delivered in Sheffield, England, in 1874).

4523

ON THE γ-γ-CORRELATION WITH HIGHER MULTIPOLES. David L. Falkoff. Phys. Rev. 82, 98-9(1951) Apr. 1. (Letter to the editor)

Note is made of several methods of calculation which considerably simplify the problem of extending the γ-γ angular correlation data to higher multipoles. A general

method of obtaining complete tabulations is indicated with specific results presented for some of the simpler cases. 7 references.

NUCLEAR PROPERTIES

4524

Knolls Atomic Power Lab.

ODD-EVEN ALTERNATIONS OF NUCLEAR RESONANCES. Henry Hurwitz, Jr. May 18, 1951. Decl. June 5, 1951. 10p. (AECD-3166)

By using a chain reacting assembly made with comparatively small amounts of moderator, the effect of very low energy capture cross sections as measured in thermal reactors has been eliminated. The absorption cross sections of various elements have been measured and are plotted. There are marked dips in the cross sections for elements in the region of the magic numbers. These occur for Z = 26, 50, and 82, due to the protons, and for Z ~ 40 (N = 50), Z ~ 57 (N = 82), and Z ~ 83 (N = 126). The general trend of the cross sections as a function of Z is for the cross sections to increase as Z increases. Another feature of the data is the systematic difference between the cross sections for even and odd elements. The even elements have cross sections which are consistently lower than those of the odd elements in the same region. When the even cross sections are multiplied by 3.5, a plot is obtained consisting of a single curve which fits the data for both even and odd elements. These data are plotted together with data obtained from measurements of the activation cross sections of numerous isotopes for Be γ-n neutrons produced by a 2-Mev x-ray machine. The γ-n neutrons which had initial energies up to 300 kv were slowed down to much lower energies by the Be. Cd and B filters were placed around the samples to eliminate the neutrons at and near thermal energies. Results were obtained for three filters which gave effective neutron energies estimated to be 300, 2000, and 5000 ev.

4525

Los Alamos Scientific Lab.

ON NUCLEAR QUADRUPOLE MOMENTS. R. Sternheimer. [nd] 34p. (AECU-1483; LADC-1003)

The correction to nuclear quadrupole moments on account of the quadrupole moment induced in the electron shells has been obtained by solving the Schroedinger equation for the perturbed core wave functions for Li, Al, and Cl. The correction factor by which the average $\langle 1/r^3 \rangle$ over the valence electron function in the equation for the quadrupole coupling should be multiplied to take account of the induced effect is 1.11, 0.83, and 0.68, respectively. The previously described (Phys. Rev. 80, 102(1950)) Thomas-Fermi calculation of this effect has been carried out for 13 additional elements. (auth)

4526

Oak Ridge National Lab.

STABLE-ISOTOPE CROSS SECTIONS, sect. 7 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. H. Pomerance and T. Arnette. Mar. 15, 1951. 2p. (ORNL-940(sect. 7))

Thermal-neutron cross sections measured with the pile oscillator are listed for a total of 22 stable isotopes of the elements Mg, Si, Ti, Se, and Te.

4527

Radiation Lab., Univ. of California

INTERPRETATION OF (d,n) ANGULAR DISTRIBUTIONS. (abstract) W. Heckrotte and L. Schecter. Mar. 1, 1951. 1p. (UCRL-1158)

The report is reproduced here in its entirety.

Recently, determinations have been made of the spatial distributions of neutrons which result from bombardment of various targets by 20-Mev deuterons from the 60-in. cyclotron at Berkeley. In some cases the distributions show small-angle structure which can be interpreted by the mechanism recently proposed by S. T. Butler (Phys. Rev. 80, 1095(1950)). This structure is determined by the spins and parities of the nuclear states involved. The experimental method does not allow an identification of the states of the final nucleus, and the observed distributions result from a superposition of the contributions from the various final states. But in the cases of Be^9, Al^{27}, and Cu^{63}, it is possible to show that probably only one of the final states enters in determining the angular distribution. For the $Be^9(d,n)B^{10}$ reaction, production of the ground state of B^{10} only was assumed, and the theoretical and experimental agreement is good enough to assign parity and possible spin values to Be^9. For the $Al^{27}(d,n)Si^{28}$ reaction, similar considerations show that production of the ground state of Si^{28} is unlikely, and the parity and the possible spin values of the resulting excited state have been determined. Similar information is also possible from the $Cu^{63}(d,n)Zn^{64}$ reaction.

4528

THE DENSITY OF STATES IN LIGHT NUCLEI. Charles L. Critchfield and Sophie Oleksa. Phys. Rev. 82, 243-7 (1951) Apr. 15.

The number of states of energy less than 25 Mev is calculated for a simple model of a nucleus of 20 nucleons. Kinetic energy and the effect of symmetry on the potential energy were considered to be the only systematic contributions to the excitation. A method of classification of states by supermultiplets, using mainly their projections on the S-T plane, is presented. An empirical formula for level density in light nuclei is deduced. (auth)

4529

INFLUENCE OF THE ATOMIC SHELL ON NUCLEAR ANGULAR CORRELATION IN Cd^{111}. H. Aeppli, A. S. Bishop, H. Frauenfelder, M. Walter, and W. Zünti. Phys. Rev. 82, 550(1951) May 15. (Letter to the editor)

The possibility of influencing the angular correlation of successive nuclear radiations (Frauenfelder, Phys. Rev. 82, 549-50(1951) May 15) has been proved in the case of Cd^{111}. The "double stream" method (Frauenfelder, Helv. Phys. Acta 23, 347(1950)) was used in preparing the sources. A table gives the angular correlation of Cd^{111} in 16 different media.

4530

NUCLEAR GYROMAGNETIC RATIOS. III. Robert E. Sheriff and Dudley Williams. Phys. Rev. 82, 651-5(1951) June 1.

The super-regenerative oscillator techniques described in earlier reports have been modified by introduction of a tuned narrow band amplifier with chart recorder and by improvements in magnetic-field regulation. Magnetic resonance frequencies of various nuclei have been compared with the resonance frequencies of H^1, D^2, Li^7, and Sc^{45}, which have been used as "standards." Ratios of the observed resonance frequencies to the proton resonance frequency in the same magnetic field are given for the following nuclear species: Be^9, B^{11}, F^{19}, Na^{23}, Al^{27}, P^{31}, V^{51}, Mn^{55}, Cu^{63}, Cu^{65}, Br^{79}, Br^{81}, Rb^{87}, Nb^{93}, I^{127}, Cs^{133}, La^{139}, Tl^{203}, and Tl^{205}. The nuclear magnetic moments of these species have been determined in terms of the proton moment from the known spins and the observed frequency ratios after making diamagnetic corrections; values for the nuclear magnetic moments are listed. (auth)

4531
NUCLEAR MAGNETIC MOMENTS AND SIMILARITY BETWEEN NEUTRON AND PROTON STATES IN THE NUCLEUS. A. L. Schawlow and C. H. Townes. Phys. Rev. 82, 268-9(1951). Apr. 15. (Letter to the editor)

Predictions of magnetic moments of odd-neutron nuclei, as calculated by comparison with magnetic moments of corresponding odd-proton nuclei, are tabulated. Magnetic moments of odd-proton and corresponding odd-neutron nuclei are shown to lie at about the same fractional distance between the Schmidt limits given by the extreme single particle model.

4532
THE NUCLEAR SPINS AND QUADRUPOLE MOMENTS OF STABLE GERMANIUM ISOTOPES. J. M. Mays and C. H. Townes. Phys. Rev. 81, 940-1(1951) Mar. 15.

Analysis of the hyperfine structure of spectral lines arising from the $J = 0 \rightarrow 1$ rotational transition of GeH_3Cl allows the assignment of zero spin to the nuclei of Ge^{70}, Ge^{72}, Ge^{74}, and Ge^{76}, and a spin of $\frac{9}{2}$ to Ge^{73}. The nuclear quadrupole moment of Ge^{73} is determined to be $(-0.2 \pm 0.1) \times 10^{-24}$ cm^2. (auth)

4533
ON NUCLEAR MAGNETIC MOMENTS OF Ag ISOTOPES AND ON THE ISOTOPIC SHIFT IN THE SPECTRUM OF SILVER. P. Brix, H. Kopfermann, R. Martin, and W. Walcher. Naturwissenschaften 38, 68-9(1951) Feb. (In German)

The hfs of AgI resonance lines was observed by the optical atom-beam method. An electromagnetic separation of the isotopes Ag^{107} and Ag^{109} permitted a correct attribution of the spectral-line components to respective isotopes, a determination of the sign of the isotopic shift in the line observed, and a new measurement of magnetic nuclear moments. The latter are $\mu_{107} = -0.111$ and $\mu_{109} = -0.129$ magnetic nuclear moment units.

4534
THE QUADRUPOLE MOMENT RATIO OF Cl^{35} AND Cl^{37} FROM PURE QUADRUPOLE SPECTRA. Ralph Livingston. Phys. Rev. 82, 289(1951) Apr. 15. (Letter to the editor)

Resonance absorption lines due to nuclear quadrupole splittings have been observed in several solid chlorine compounds. A frequency modulated regenerative oscillator was used, and the absorption lines were viewed on an oscilloscope. The frequency ratios $\nu(Cl^{35})/\nu(Cl^{37})$ should be the nuclear quadrupole moment ratio of Cl^{35} and Cl^{37}. The average gives $Q(Cl^{35})/Q(Cl^{37}) = 1.26878 \pm 0.00015$. The eight ratios tabulated agree to within ± 0.00005.

4535
THE RAMAN SPECTRUM OF FLUORINE. D. Andrychuk. Can. J. Phys. 29, 151-8(1951) Mar.

The rotational and vibrational Raman spectra of gaseous Fl at 1 atm pressure have been obtained. From these spectra the constants of the molecule in the electronic ground state were determined as $B_0 = 0.8828$ cm^{-1}, $r_0 = 1.417_7 \pm 0.001$ A, and $\Delta G_{\frac{1}{2}} = 891.8_5 \pm 0.4$ cm^{-1}. The intensity alternation in the rotational spectrum shows that the nuclear spin of Fl is $\frac{1}{2}(h/2\pi)$ and that the F^{19} nuclei follow Fermi statistics. (auth)

4536
RETARDED NUCLEAR INTERACTION. S. T. Ma. Phys. Rev. 82, 275-6(1951) Apr. 15. (Letter to the editor)

An example is cited which shows that Dirac's relativistic equation for two particles, which deals with particles with energies of both signs, does not always agree with the hole theory, in which the negative energy states are correlated to pair creation.

4537
THE SPECTURM OF He^3 I. Mark Fred, Frank S. Tomkins, James K. Brody, and Morton Hamermesh. Phys. Rev. 82, 406-21(1951) May 1.

Helium isotope shift measurements previously reported have been extended and the He^3 hyperfine structure has been partially resolved. The hfs of the ^3S levels is inverted, indicating a negative nuclear magnetic moment as expected. The splitting of the 2^3S level is 0.221 ± 0.005/cm, while higher ^3S levels have a splitting of about 0.216/cm, agreeing exactly with the expected values. The observed hfs agrees very well with that calculated by taking into account the perturbations of neighboring fine structure levels. The stronger hfs components of transitions to the ^3P and ^3D levels are not resolved, but the structure must be considered in evaluating the isotope shifts. By including contributions from reduced mass and coupling effects, it is found that the predicted and observed shifts differ by ~0.1 cm^{-1} in the sense that the H^3 ^3S and ^3D terms are higher and the ^1S and ^1D terms lower than expected, with respect to the ^3P and ^1P levels. 3 references. (auth)

4538
THE TOTAL CROSS SECTION OF BERYLLIUM, ALUMINUM, SULPHUR, AND LEAD FOR NEUTRONS OF ENERGIES FROM 2 MEV TO 6 MEV. G. H. Stafford. Proc. Phys. Soc. (London) 64A, 388-95(1951) April.

The total neutron cross sections of Be, Al, S, and Pb have been measured in the range of energies 2 to 4 Mev and 5 to 6 Mev by a transmission experiment. Resonances were observed in all four elements. The results obtained for Pb and Be are compared with those expected according to the one-body theory for light nuclei. (auth)

NUCLEAR REACTORS

4539
Westinghouse Atomic Power Div.
AUTOMATIC CONTROL OF POWER REACTORS. M. A. Schultz. Nov. 6, 1950. Decl. May 24, 1951. 42p. (AECD-3163; WAPD-24)

The use of automatic controls for power producing reactors is discussed with reference to start-up, operating, and shut-down problems. The transfer function of a reactor is obtained theoretically and the requirements of a servo-system design are discussed. Automatic control systems are presented for subcritical operation as well as for power-range work. The use of the control system in prevention of enforced shutdowns is also indicated. (auth)

4540
Technical Information Service, AEC
SELECTED UNCLASSIFIED REFERENCES ON NUCLEAR REACTORS. Technical Information Service Staff. [nd] 11p. (TID-3006)

A bibliography is given of references which have been selected to supply background and survey information on nuclear reactors without the details necessary for a specialized study.

NUCLEAR TRANSFORMATIONS

4541
Argonne National Lab. and Physics Research Lab., Univ. of Illinois
THRESHOLD FOR PHOTO-NEUTRON REACTION IN Th^{232}. L. B. Magnusson, J. R. Huizenga, P. R. Fields, M. H. Studier, and R. B. Duffield. June 5, 1951. Decl. July 16, 1951. 3p. (AECD-3199; ANL-WMM-867)

Samples of Th nitrate were bombarded in the betatron x-ray beam at energies from 6.71 to 9.97 Mev. The bombarded Th was chemically purified to remove fission products and Th daughters and the Th^{231} activity was measured with a thin window Geiger tube. Observed Th^{231} activities ranged from 2 to 60 cpm. The square root of the total Th^{231} activity divided by the total roentgens was found to be a linear function of bombardment energy. Results are plotted. Visual extrapolation gives a threshold of 6.35 ± 0.05 Mev for the $Th^{232}(\gamma,n)Th^{231}$ reaction.

4542
Oak Ridge National Lab.
ACCELERATOR PROGRAM, sect. 6 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. W. M. Good, C. D. Moak, G. Robinson, and H. Willard. Mar. 15, 1951. 3p. (ORNL-940(sect. 6))

Improvements in pulse-height selector, collimator, and monitoring of the beam energy have been effected, and the γ-ray spectrum from protons bombarding B^{11} has been obtained. The angular distribution of γ rays in the neighborhood of one of the peaks in the spectrum shows definite anisotropy. (auth)

4543
Radiation Lab., Univ. of California
SUMMARY OF THE RESEARCH PROGRESS MEETING OF JANUARY 11, 1951. R. K. Wakerling. Apr. 5, 1951. 11p. (UCRL-1177)

A 0.177-sec emitter, tentatively identified as Li^9 was obtained by 190-Mev deuteron bombardment of B and Be. An oscilliscope screen displaying a scaled output of BF_3 chamber pulses was exposed to rapidly moving film for the observation. More evidence of deuteron formation in the reaction $p + p \rightarrow \pi + d$ was observed by a coincidence technique. By the use of a magnetic field to determine the momentum of the particles and by finding the ranges of the particles in Al, the reaction products have been identified by essentially measuring their masses. Deuteron mass calculated was 2.2 (+0.6, −0.4) proton masses. Meson mass was 270 (+80, −90) electron masses.

4544
ANGULAR DISTRIBUTION OF FAST NEUTRONS FROM DEUTERON BOMBARDMENT. K.-H. Sun, D. Harris, F. A. Pecjak, B. Jennings, A. J. Allen, and J. F. Nechaj. Phys. Rev. 82, 266-7(1951) Apr. 15. (Letter to the editor)

Further measurements (Allen et al., Phys. Rev. 81, 536 (1951)) have been made on the angular distribution of neutrons from 15-Mev deuterons on Be, using improved experimental arrangements and higher-energy neutron threshold detectors. These new threshold detectors made use of the reactions $Al^{27}(n,\alpha)Na^{24}$, $Ta^{181}(n,2n)Ta^{180}$, and $F^{19}(n,2n)F^{18}$. The shape of the angular distributions for Al- and Ta-detectors is similar to that of S-detectors. For the F-detector, the double peaks are clearly resolved.

4545
BETA-ALPHA-CORRELATION IN THE DISINTEGRATION OF Li^8. J. W. Gardner. Phys. Rev. 82, 283-4(1951) Apr. 15. (Letter to the editor)

Theoretical consideration is given to the disintegration $Li^8 \rightarrow 2He^4 + e^- + \nu$. The only likely β-decay schemes for $Li^8 \rightarrow Be^{8*}$ are: (1) 0+ → 2+, second forbidden (axial vector interaction); (2) 3− → 2+, first forbidden (axial vector or tensor interaction). It is concluded that if the β-α angular distribution at high β energies shows any correlation at all, the Be^{8*} has spin 2, and either scheme (1) or scheme (2) applies according as the distribution does, or does not, have a maximum between 0 and 90°. An isotropic distribution probably, but not certainly, means spin 0 for the Be^{8*}.

4546
CROSS SECTION FOR THE REACTION $C^{12}(\gamma,n)C^{11}$. R. N. H. Haslam, H. E. Johns, and R. J. Horsley. Phys. Rev. 82, 270-1(1951) Apr. 15. (Letter to the editor)

The cross-section curve for the reaction $C^{12}(\gamma,n)C^{11}$ has been redetermined (G. S. Baldwin and G. S. Klaiber, Phys. Rev. 73, 1156(1948)). The curve has a peak value of 11.6 millibarns at 22.4 ± 0.5 Mev. The integrated cross section is 0.047 Mev-barn. A saturated specific activity curve for $C^{12}(\gamma,n)C^{11}$ as a function of maximum betatron energy, and a self-absorption curve for the positron activity of C^{11} are also included.

4547
DETERMINATION OF THE PHOTO-NUCLEAR CROSS SECTIONS $S^{32}(\gamma,d)P^{30}$, $S^{32}(\gamma,np)P^{30}$, AND $P^{31}(\gamma,n)P^{30}$. L. Katz and A. S. Penfold. Phys. Rev. 81, 815-19(1951) Mar. 1.

The photonuclear cross sections for the γ-deuteron and γ-neutron proton, reactions of the parent isotope S^{32} were measured. Sulfur samples were irradiated in the photon beam from the University of Saskatchewan's 22-Mev betatron and an activity curve was obtained. The activity curve was analyzed to give a cross-section curve that had a peak value at 26 Mev and an indication of the possible existence of another peak at 24 Mev. The observed threshold energy was 19.15 ± 0.20 Mev. The cross-section curve can be interpreted to be the result of a superposition of a γ-deuteron cross section and a γ-neutron proton cross section with peak values of 0.7 ± 0.1 and 1.5 ± 0.2 mb, respectively. The γ-neutron cross section from the parent isotope P^{31} was also measured. This curve had a threshold at 12.4 ± 0.2 Mev and the peak occurred at 19 Mev. The peak value was 17 ± 2 mb and a half-width energy of 7.6 Mev. (auth)

4548
ELECTRIC EXCITATION AND DISINTEGRATION OF NUCLEI. I. EXCITATION AND DISINTEGRATION OF NUCLEI BY THE COULOMB FIELD OF POSITIVE PARTICLES. Charles J. Mullin and Eugene Guth. Phys. Rev. 82, 141-55(1951) Apr. 15.

General formulas for the cross section for the 2^l-pole excitation (or disintegration) of a nucleus by the electric field of a nonrelativistic positively charged projectile have been obtained by using the Born approximation; the finite size of the nucleus has been taken into account. For electric dipole and quadrupole excitation a more accurate evaluation has been made in which the initial and final states of the charged projectile are described by the exact coulomb field wave functions. A relation is established between the virtual quanta representing the coulomb field of the projectile and the real quanta of the x-ray spectrum corresponding to the scattering process. The theory of electric transitions has been applied, in some detail, in a discussion of (1) the inelastic scattering of deuterons and (2) the electric breakup of the deuteron when it "collides" with a target nucleus. (auth)

4549
EMISSION OF PROTONS FROM THE COMPOUND NUCLEUS F^{18*}. R. R. Roy. Phys. Rev. 82, 227-8(1951) Apr. 15.

The emission of protons from the reaction $N^{14}(\alpha,p)O^{17}$ was studied by photographic emulsion technique. Two groups of protons were observed, of Q values of about −1.16 Mev and −2.0 Mev for E_α = 3.6 Mev and 4.2 Mev. The yield per million incident α particles has been estimated at 0.348 and 0.409 for the two resonance levels, 3.6

Mev and 4.2 Mev, respectively. The angular distribution of protons in the CM system has a maximum at $\theta = 90°$ for the two ground states, and, for the excited states, it is isotropic. (auth)

4550

ENERGY LEVEL AT 31 KEV IN Al^{28} FROM Al^{27} (d,p)Al^{28} REACTION. H. Enge, W. W. Buechner, A. Sperduto, and D. M. Van Patter. Phys. Rev. 83, 31-3(1951) July 1.

The proton group previously assigned to the ground state of Al^{28} from the Al^{27}(d,p)Al^{28} reaction has been found to be a doublet, the low energy member of which is ascribed to an excited state at 31.2 ± 2.0 kev. The Q-value corresponding to the Al^{28} ground state has been measured as 5.494 ± 0.010 Mev. The Q-value corresponding to the ground state of Mg^{25} in the Al^{27}(d,α)Mg^{25} reaction is 6.694 ± 0.010 Mev, and the first excited level in Mg^{25} is at 0.584 ± 0.006 Mev. (auth)

4551

ENERGY LEVELS OF B^{11} FROM THE B^{10}(d,p)B^{11*} REACTION. D. M. Van Patter, W. W. Buechner, and A. Sperduto. Phys. Rev. 82, 248-57(1951) Apr. 15.

The proton groups from enriched B^{10} bombarded by 1.51-Mev deuterons have been investigated by means of a magnetic spectrograph of high resolution. Eleven proton groups were assigned to the reaction B^{10}(d,p)B^{11}, corresponding to the ground state and ten excited states of B^{11}. Five of these excited states have not been previously reported. At 6.8-Mev excitation of B^{11}, a doublet was observed with a level spacing of 50.0 ± 2.0 kev. The range of excitation of B^{11} covered in these experiments was from 0 to 10.2 Mev. (auth)

4552

THE EXCITATION FUNCTIONS FOR B^{10}(d,α)Be^{8}. W. D. Whitehead. Phys. Rev. 82, 553-4(1951) May.

The excitation functions for the ground-state group and the first excited state group for B^{10}(d,α)Be^{8} have been determined by bombarding thin targets (375 μg/cm²) of isotopically enriched B (96% B^{10}) and of normal B with deuterons from the Bartol van de Graaff generator, and observing the reaction α particles with an argon-filled proportional counter, biased to count the α's at the end of their range, at 90° to the incident beam. The Q values determined are 17.92 ± 0.15 Mev for the ground state, and 15.19 ± 0.15 Mev for the first excited state. The mass of Be^{8} is 8.00780 ± 0.0016 amμ, and it is unstable to α emission by 0.110 ± 0.150 Mev. The width of the first excited level in Be^{8} is 0.95 ± 0.20 Mev.

4553

EXCITATION FUNCTION OF C^{14}(α,p)N^{17}. K.-H. Sun, B. Jennings, and W. E. Shoupp. Phys. Rev. 82, 267-8(1951) Apr. 15. (Letter to the editor)

The excitation function of the reaction C^{14}(α,p)N^{17} was measured by monitoring the delayed neutrons, emitted by the product nuclide N^{17}, at various α energies. The experimental setup is shown. The cross section of the C^{14}(α,p)N^{17} for 27-Mev α particles was estimated to be about 6×10^{-28} cm².

4554

EXCITED STATES OF THE MIRROR NUCLEI, Li^{7} AND Be^{7}. A. B. Brown, C. W. Snyder, W. A. Fowler, and C. C. Lauritsen. Phys. Rev. 82, 159-81(1951) Apr. 15.

By studying the α particles emitted in the disintegration of B^{10} by protons it has been shown that there exists an excited state in Be^{7} at 434.4 ± 4 kev which corresponds to the well-known first excited state in the mirror nucleus, Li^{7}. Measurements on the inelastic scattering of protons in Li^{7} yield a value 479.0 ± 1.0 kev for the energy of the Li^{7}. The existence of these mirror states adds support to the equality of the p-p and n-n interactions exclusive of electrostatic and magnetic forces. The small difference, 45 ± 4 kev, in the excitation energies is larger than second-order electric effects and is believed to be consistent with the order of magnitude of magnetic interactions in nuclei. The splitting of the ground and excited states must arise in some specific property of the nuclear interactions. In connection with the energy determinations, a detailed discussion is given of the precise measurements of the Q-values of nuclear reactions employing high resolution analyzers, electrostatic and magnetic, in the determination of particle energies. Experimental determinations of the cross sections for B^{10}(p,α)Be^{7}, B^{10}(p,α')Be^{7*}(γ)Be^{7}, B^{10}(p,p)B^{10}, Li^{7}(p,p)Li^{7}, and Li^{7}(p,p')Li^{7*}(γ)Li^{7} are given. (auth)

4555

INTERPRETATION OF THE DECAY SCHEME OF K^{40}. P. Morrison. Phys. Rev. 82, 209-11(1951) Apr. 15.

The three ground states and one excited state of the three nuclei involved in the disintegration of K^{40} are assigned parity and angular momentum values which are essentially unique. The rates of all measured transitions and such energy differences as are well known are used for the assignment, which depends on the j-j coupling shell model, the Gamow-Teller selection rules, and certain empirical groupings of β-ray lifetimes. Appreciable K capture directly to the ground state of A^{40} can be excluded on these quasi theoretical grounds. (auth)

4556

THE Mn^{55}(p,n)Fe^{55} NEUTRON SPECTRUM. P. H. Stelson and W. M. Preston. Phys. Rev. 82, 655-7(1951) June 1.

A thin (20-kev) target of Mn on a Ta backing was bombarded by monoenergetic protons of 2.97, 3.42, and 3.77 Mev from the Rockefeller electrostatic generator. Nuclear emulsion plates (Eastman NTB, 200 μ thickness) were mounted 15 cm from the target at 0 and 90° with respect to the incident proton beam. The resulting neutron spectra, obtained from the analysis of 2400 proton recoil tracks, show well-defined groups which correspond to excited states in Fe^{55} at 0.42, 0.94, 1.36, and 2.08 Mev. The group corresponding to the level at 1.36 Mev has an unusually large width indicating that this level is complex. The Q-value for the ground-state reaction was measured to be −1.05 ± 0.05 Mev, giving the threshold for neutron production as 1.07 ± 0.05 Mev. Levels in Fe^{55} at 0.935 and 1.41 Mev have been found by Deutsch and Hedgran (Phys. Rev. 75, 1443(1949)) from a study of the decay scheme of Co^{55}. These levels correspond closely to two of the levels reported here. (auth.)

4557

PHOTODISINTEGRATION OF COPPER. P. R. Byerly, Jr., and W. E. Stephens. Phys. Rev. 83, 54-62(1951) July 1.

The energy and angular distributions of the protons, deuterons, and alpha-particles and the energy distribution of neutrons emitted from copper nuclei irradiated with the x-rays from a 24-Mev betatron were determined with the use of of photographic emulsions. The yields of neutrons, protons, deuterons, and alpha-particles were observed to be 3.6, 1.07, 0.34, and 0.04×10^{6} particles, respectively, per mole per roentgen unit. A comparison of the neutron: proton yields and the energy distribution with the theoretical predictions of the statistical models and direct photoelectric action indicate that the photodisintegration of copper consists mainly in the evaporation of nuclear particles from the excited nuclei. However, the large numbers of deuterons observed can only be explained by a different mechanism such as the "pick up" of a proton by an emerging neutron. About 10 per cent of the neutrons and protons have energies greater than

expected from evaporation. These are ascribed to a direct photoelectric effect. The observed angular anisotropy of these high energy protons supports this interpretation. (auth)

4558
THE PHOTODISINTEGRATION OF He^4 NUCLEI BY X-RAYS FROM A 100-MEV BETATRON. E. R. Gaerttner and M. L. Yeater. Phys. Rev. 83, 146-50(1951) July 1.

The photodisintegration of He^4 nuclei has been studied in a cloud chamber, with a 100-Mev betatron as a source of x-rays. The predominant reactions observed are $He^4(\gamma,p)H^3$ and $He^4(\gamma,n)He^3$. The angles, θ, at which the protons from the (γ,p) reaction are emitted with respect to the x-ray beam are consistent with a $\sin^2\theta$ distribution. The measured average energy of the x-ray photons producing the γ-p disintegration is approximately 27 Mev. The total integrated photodisintegration cross section is 0.1 ± 0.05 Mev-barn; this value is based on an earlier determination of the absolute nitrogen cross section, obtained by a direct comparison of the number of nuclear disintegrations with the number of positron-electron pairs produced in the gas in the cloud chamber. (auth)

4559
THE REACTION $^7Li(d,\alpha)$ AND THE GROUND STATE OF ^5He. A. P. French and P. B. Treacy. Proc. Phys. Soc. (London) 64A, 452-8(1951) May.

A differential ionization chamber with electron collection has been designed for the study of α-particle spectra. Two chambers of this type have been used to investigate α-α coincidences in the reaction $Li^7(d,\alpha n)He^4$. The results confirm that this process takes place, and the observed angular correlation of successive α particles lends some support to the view that the virtual ground state of He^5 is $P_{\frac{3}{2}}$. (auth)

4560
RELATIONSHIP BETWEEN THE ENERGY SPECTRUM OF PROTONS PRODUCED IN THE $C^{12}(d,p)C^{13}$ REACTION AND THE POSSIBLE EXCITED STATES OF C^{13}. PART I. W. M. Gibson and J. Catalá de Alemany. Anales real soc. españ. fís. y quím. 46A, 307-16(1950) Nov.-Dec. (In Spanish)

Several writers have reported the existence of the lowest excited state of C^{13} at 0.8 Mev. The present authors did not find any tracks of protons, corresponding to that energy level, among the products of the reaction $C^{12}(d,p)C^{13}$ observed in Ilford C2 emulsions.

4561
SOME GAMMA-RAYS FROM LIGHT ELEMENTS UNDER PROTON BOMBARDMENT. J. H. Carver and D. H. Wilkinson. Proc. Phys. Soc. (London) 64A, 199-201(1951) Feb.

The energy of the photoprotons from deuterium, measured in an ionization chamber has been used to determine the energy of γ rays produced by the proton bombardment of several light elements. The results are expressed in the following tabulation.

Isotope	Target thickness (kev)	Proton energy (kev)	Gamma-ray energy (Mev)
Be^9	2	1000	7.39 ± 0.15
B^{11}	200	950	12.50 ± 0.21
C^{13}	20	570	8.14 ± 0.08 5.81 ± 0.25
F^{19}	thick	740	12.09 ± 0.28
Li^7	thick	500	14.4 ± 0.4
N^{15}	unknown	900	4.45 ± 0.04

The absence of certain well-known lines from the above table merely means that their energy was not determined in this investigation. (auth)

4562
THE T + T REACTIONS. K. W. Allen, E. Almqvist, J. T. Dewan, T. P. Pepper, and J. H. Sanders. Phys. Rev. 82, 262-3(1951) Apr. 15. (Letter to the editor)

To distinguish the three possible nuclear reactions brought about by the interaction of tritons with tritons, measurements have been made of the energies of the disintegration products emitted at 90° to the triton beam. The observed α-particle energy distribution is due largely to the 3-body disintegration $T + T \rightarrow He^4 + 2n + 11.3$ Mev. No group was found to correspond to the formation of a di-neutron, but there is some evidence of the formation of He^5 in its unstable ground state.

PARTICLE ACCELERATORS

4563
Los Alamos Scientific Lab.
TESTS OF A LOW-GAS-CONSUMPTION MAGNETIC ION SOURCE. George W. Farwell. May 29, 1951. 20p. (LA-1260)

Ion yields from a magnetic ion source of the type described by Kistemaker and Dekker (Physica 14, 198 and 209 (1950)), and Bakker and Kistemaker (Helv. Phys. Acta 23, Sup. III. 46(1950)) have been studied with the aid of a crossed-field analyzer. Stable operation with He in the pressure range of 1 to 4 μ Hg yields resolved He^+ ion beams up to 70 μA, with a He gas flow of less than 3 cc/hr. Total ion production is several times this large. When used with H or N the source gives ion yields comparable to the He ion yield. The effects of variations in a number of ion source parameters have been studied. (auth)

4564
Los Alamos Scientific Lab.
ON THE USE OF A ZINN-TYPE ION SOURCE WITH HELIUM. Richard C. Cornelius and George W. Farwell. May 22, 1951. 20p. (LA-1261)

A crossed-field analyzer has been used in a study of the production of H and He ions by a Zinn-type ion source. He and H ion yields are comparable. The optimum He operating pressure is two to there times the optimum H operating pressure. The optimum anode voltage is slightly higher for H than for He. Characteristics of an accelerating geometry which permits use of a differential pumping arrangement to remove about 99% of the gas leaving the ion source have been studied at low accelerating voltages. (auth)

4565
Research Lab. of Electronics, Mass. Inst. of Tech.
AXIALLY SYMMETRIC ELECTRON BEAM AND MAGNETIC FIELD SYSTEMS. (Technical Report No. 170) L. A. Harris. Aug. 29, 1950. 78p. (NP-3106)

The theory of longitudinally uniform and axially symmetric electron beams focused by a uniform axial magnetic field is presented. A general graphical method is described for obtaining the potential distribution required for the design of hollow beams. The necessity of bringing the beam through a transition region where electrons acquire their angular velocity restricts the problem to two categories in which the cathode is either in a uniform magnetic field or in a magnetically shielded region. Special cases are the solid beam, the hollow beam with uniform radial charge density, the hollow beam between coaxial electrodes at the same potential, and the hollow beam inside an outer electrode only. Of interest is the case of a hollow beam focused with a magnetic field in the cathode region only. Explicit design equa-

tions are presented for all cases. The possible effects of incidental ionization are briefly considered. Experimental results confirm the theory qualitatively and to a considerable extent quantitatively, and indicate the importance of the cathode flux condition and the need for a good method of bringing the beam through the transition region. 20 references. (auth)

4566

ELECTRONICS IN PARTICLE ACCELERATORS. T. M. Dickinson and T. W. Dietze. Proc. Natl. Electronics Conference 6, 459-70(1950) Sept. 25-27.

This paper briefly describes the operating fundamentals of various accelerators and then goes into some detail on the more interesting and unusual electronic circuits devised to meet the special problems.

4567

INSTRUMENTATION OF THE M.I.T. CYCLOTRON FOR THE STUDY OF NUCLEAR REACTIONS. Keith Boyer, H. E. Gove, J. A. Harvey, Martin Deutsch, and M. Stanley Livingston. Rev. Sci. Instruments 22, 310-20(1951) May.

The emergent beam from the cyclotron has been focused to bombard targets placed in an evacuated chamber behind shielding walls. Heavy charged particle products from the targets can be counted and identified as to charge and mass by three proportional ionization chambers in time coincidence, utilizing the difference in specific ionization near the end of the particle range. Energy spectra at fixed angles are observed with an automatic foil changer which interposes aluminum absorbers between target and detector. Angular distributions can be studied by rotating the detector about the target with a remote-controlled selsyn drive. Rapid automatic recording of data is accomplished with count storage circuits, a beam current integrator, mechanisms for scanning through a preselected set of absorber foils, and a pen-recorder. Reactions studied to date include (d,p), (d,t), (d,α), (p,d), and elastic and inelastic scattering of protons, deuterons, and α particles. Targets throughout the periodic table have been used, with special emphasis on the elements available in thin foil form. (auth)

4568

A NEW BETATRON CONTAINING LITTLE IRON. Braunbek. Umschau 51, 308-9(1951) May 15. (In German)

A 9-Mev betatron weighing only 50 kg was recently constructed by the firm Philips. Only a small iron core is used for the central induction field, the peripheral guiding field being produced by two air-core coils. The high-current intensity required by such a construction is furnished by discharges of a 1000-μf condenser charged every second to 5×10^4 v; the period of the oscillating discharges is 2500 cps.

4569

SCATTERING LOSSES IN THE SYNCHROTRON. J. Mayo Greenberg and T. H. Berlin. Rev. Sci. Instruments 22, 293-301(1951) May.

Scattering losses in various electron and proton synchrotrons by residual gas molecules are obtained for a variety of conditions. Evaluation is made of the effects of (1) injection energy of the particles, (2) the spread of the injected beam, (3) the pressure of the residual gas, (4) the rate at which energy is supplied to the beam particles, and (5) the aperture of the accelerator. It is shown that multiple scattering is the really important factor and that losses due to single scattering are of relative importance only when the total effect of single and multiple scattering is rather small. Scattering losses are tabulated and estimates made of the residual gas pressures in synchrotrons which will not produce prohibitively large losses. (auth)

RADIATION ABSORPTION AND SCATTERING

4570

Oak Ridge National Lab.

PILE NEUTRON PHYSICS (Lecture Notes); CHAPTER II. SECOND-ORDER DIFFUSION THEORY. A. M. Weinberg and L. C. Noderer. July 22, 1949. Decl. June 6, 1951. 44p. (AECD-3165; CF-49-7-235)

The "second order" diffusion theory (also referred to as the spherical harmonics method) for determining neutron distribution is described in detail. The solution of a number of standard diffusion problems are obtained by the application of this theory. A variant of the spherical harmonics method based on the Gauss integration formula and proposed by G. C. Wick (Z. Physik 121, 702(1943)) and the time-dependent Boltzmann equation are also considered.

4571

Columbia Univ.

NEUTRON SCATTERING IN THE RESONANCE REGION, II. (abstract) J. Tittman, C. Sheer, W. W. Havens, Jr., and L. J. Rainwater. [nd] 1p. (CUD-87; DR-1621)

The report is reproduced here in its entirety.

The slow neutron scattering chamber previously described (O. Frisch, Kgl. Danske Videnskab. Selskab 14, No. 12(1937); M. Goldhaber, private communication) has been further developed, and used to measure the ratio of scattering to total cross section of Au in the low energy region as a function of neutron energy. The method utilizes infinitely thick targets, the scattering from which (for the geometry used) can be shown to be described essentially by a power series in (σ_s/σ_t), provided $(\sigma_s/\sigma_t) \lesssim 0.5$ (where σ_s = scattering cross section and $\sigma^3 = \sigma_s + \sigma_c$ total cross section). The measurements are made by taking ratios of the scattered counts from the unknown Au target to that of a C reference target and comparing to a similar ratio using a standard target in place of the Au. Thick targets of Ni_2B and B_2O_3 were used for the latter and serve to calibrate the instrument since their cross sections are independently known. Detailed measurements on the 4.87-ev Au resonance have been completed and excellent agreement between the theoretical Breit-Wigner one-level formulas and the experimental curve of $(\sigma_s/\sigma_t)_{Au}$ has been obtained. These results in addition to the previously measured values of $\sigma_{co}\Gamma^2$ and the self-indication cross section for Au yield the following parameters for the 4.87-ev excited level of Au^{198}:

J	Γ	Γ_{no}	σ_{pot} (nonresonant spin state)	σ_{pot} (resonant spin state)
1	0.172 ev	0.0211 ev.	10.6 barns	13.3 barns

4572

Columbia Univ.

NEUTRON SCATTERING IN THE RESONANCE REGION, III. (abstract) C. Sheer, J. Tittman, W. W. Havens, Jr., and L. J. Rainwater. [nd] 1p. (CUD-88; DR-1622)

The report is reproduced here in its entirety.

An extension of the slow neutron scattering measurements on Au, as previously reported (Tittman, Sheer, Rainwater, and Havens, (Phys. Rev. 77, 748(1950)) into regions of higher energy, has been carried out. Results of these scattering measurements between 30 and 500 ev will be reported and compared with transmission data in the same region. Since the cross section of Au in this region is quite low, a thick target is geometrically unfeasible and hence accurate determinations of σ_s/σ_t by this method is impractical. However, the ratio of counts scattered from the Au target to that

scattered from a C reference target, which is roughly proportional to σ_s/σ_t, will be shown. These measurements indicate that this method is quite sensitive in locating weak levels which have an appreciable percentage of capture. For example, strong dips in the curve of σ_s/σ_t vs. energy have been found at 75 and 300 ev indicating the presence of levels which are so weak that their presence is barely suggested by the transmission curve. The measurement of neutron scattering from Ag by this method has been started. Preliminary results for the 5.1 and 16-ev resonances will be presented.

4573
Rochester Univ.
HIGH ENERGY PROTONS EMITTED FROM CARBON AT 90° TO A 240-MEV PROTON BEAM. G. M. Temmer. June 20, 1951. 10p. (NYO-897)

The differential cross section for the emission of protons at right angles to the 240-Mev circulating proton beam of the Rochester synchrocyclotron has been determined for C as a function of the outgoing proton energy. The energy spectrum was obtained by sampling the population of track endings in 100-μ Kodak NTA nuclear emulsions embedded at different depths of a Cu absorber. The values of the differential cross section per unit energy range per C nucleus as a function of the proton energy are shown both tabularly and graphically. Theoretical distributions, based on various models, for single collisions with a degenerate Fermi gas are shown graphically. The differential diffraction scattering cross section for C at 90° is about 4×10^{-29} cm²/steradian as calculated according to the model of Fernbach et al. (Phys. Rev. 75, 1352(1949)). 15 references.

4574
Radiation Lab., Univ. of California
ANGULAR DISTRIBUTION OF PHOTONS IN SHOWERS IN LEAD. Jack W. Rose. Mar. 5, 1951. 3p. (UCRL-995)

An abstract of the present report was also indexed as report UCRL-995 and appeared in its entirety in Nuclear Science Abstracts as NSA 5-1376.

4575
Radiation Lab., Univ. of California
EXPERIMENTS ON PROTON-PROTON SCATTERING FROM 120 TO 345 MEV. O. Chamberlain, E. Segrè, and C. Wiegand. Feb. 1951. 41p. (UCRL-1109)

The differential scattering cross section for elastic collisions of 345-Mev protons with protons has been measured in the angular range 11 to 90° (center-of-mass system). The same cross section has been measured over more limited ranges of angles at lower energies. The cross section (in the center-of-mass system) at 90° is remarkably independent of energy. The cross section at 345 Mev is very independent of angle, being close to 3.8×10^{-27} cm²/steradian (center-of-mass system). The agreement with existing phenomenological theories based on static potentials is rather poor, especially in the case of scattering at small angles at 345 Mev. 16 figures. (auth)

4576
Radiation Lab., Univ. of California
PROTON-PROTON SCATTERING AT 345 MEV. (abstract) O. Chamberlain, E. Segrè, and C. Wiegand. Mar. 1, 1951. 2p. (UCRL-1153)

The report is reproduced here in its entirety.

Previously reported (Chamberlain, Segrè, and Wiegand, Phys. Rev. 81, 234(1951)) measurements on the differential scattering cross section in elastic proton-proton collisions have been extended to include scattering of small angles from the beam. A digest of the results is contained in the following table.

Angle θ center of mass system in degrees	Differential cross section center of mass system in 10^{-27} cm²/steradian	Error (Std. Deviation) in diff. cross section in 10^{-27} cm²/steradian
Using a liquid H target		
11.3	5.2	0.5
15	3.5	0.3
21	3.3	0.3
33	3.5	0.2
43	3.4	0.2
53	3.3	0.2
Using a CH_2 target		
36	4.1	0.3
44	4.0	0.3
46	3.8	0.2
52	3.8	0.2
61	3.8	0.3
64	3.6	0.3
71	3.7	0.2
80	4.0	0.3
86	3.7	0.2

Comparisons will be made to theoretical results of R. S. Christian, R. Jastrow, and others involving both n-p and p-p scattering at high energies.

4577
Radiation Lab., Univ. of California
SUMMARY OF THE RESEARCH PROGRESS MEETING OF MARCH 15, 1951. Bonnie E. Cushman. June 27, 1951. 7p. (UCRL-1207)

New equipment (see UCRL-885-6) has been developed for use in tracing small amounts of radio-Fe in the human body. Data are given on amounts and half lives of Fe in various body parts, and measurements on normal individuals are compared with measurements on people with various disorders (polycythemia, anemia, leukemia). Experiments have been conducted for the study of polarization in n-p scattering, the azimuthal dependence of cross section in a beam of particles with spins preferentially aligned. The general shapes for the predicted angular dependence of the particle flux intensity for a tensor force model are shown. The experiment was set up so that the first scattering is done inside the tank of the cyclotron using a LiD target. The second probe is located so that the neutrons leave the tank at 30° and are scattered again by carbon or paraffin. The protons produced are detected by four double coincidence counter telescopes with liquid scintillators and the carbon-paraffin difference is taken. Preliminary results indicate that asymmetry about the counters does not seem to be present.

4578
Radiation Lab., Univ. of Calif.
I. THE SCATTERING OF HIGH ENERGY NEUTRONS BY NUCLEI II. LATERAL SPREAD OF PARTICLES IN CASCADE SHOWERS. (thesis) Sidney Fernbach. July 2, 1951. 90p. (UCRL-1382)

I. The scattering of high energy neutrons by complex nuclei is described by a simple optical model for the nucleus. This model assigns a common index of refraction and mean free path for absorption to all nuclei, these constants varying with energy, the former rapidly decreasing,

the latter slowly increasing. Cross sections are calculated from the optical model and then compared with existing experimental data. 20 references. II. A method of calculation of the distribution function resulting from cosmic ray showers is presented in quite some detail. This method consists of reconstruction of the function from a finite number of its moments. Calculations are made of the moments at the shower maximum in which an asymptotic expansion is obtained down to twice the critical energy, taking into account loss of energy by ionization. It is shown how the moments may be obtained for varying depth of the shower. The actual distribution is calculated using the moments found by these methods.

4579

THE ABSOLUTE ABSORPTION COEFFICIENT OF GERMANIUM AND THE FINE STRUCTURE IN THE K EDGE OF SOME OF ITS COMPOUNDS. H. Glaser. Phys. Rev. 82, 616-21(1951) June 1.

The fine structure of the K absorption limit of Ge in GeH_4, Ge_2H_6, $GeCl_4$, and $GeBr_4$ has been obtained with absolute values under conditions of high resolution with a double crystal x-ray spectrometer. Results are compared with existent theory, and previous measurements and discrepancies are pointed out. The question of the location of an absorption edge is considered along with the Kossel structure appearing in the germanium hydrides. (auth)

4580

DIFFUSE X-RAY SCATTERING BY DISORDERED BINARY ALLOYS. William J. Taylor. Phys. Rev. 82, 279-80(1951) Apr. 15. (Letter to the editor)

The x-ray scattering from binary alloys of the substitutional type shows two effects due to the degree of order (or disorder): (1) Sharp superlattice reflections when long-range order is present; and (2) diffuse scattering which depends on the degree of short-range order. In the present note a general method of treatment is outlined which introduces the short-range order parameters in a particularly straightforward way.

4581

EFFECT OF SHORT WAVELENGTH INTERFERENCE ON NEUTRON SCATTERING BY DENSE SYSTEMS OF HEAVY NUCLEI. G. Placzek, B. R. A. Nijboer, and L. Van Hove. Phys. Rev. 82, 392-403(1951) May 1.

The interference term in the expression for the total cross section for scattering of neutrons by dense systems of heavy nuclei is investigated in the region of small wavelength. Asymptotically, this term has the form $\delta\sigma/\sigma = -(\lambda^2\rho^{2/3}/8\pi)I$ where λ is the neutron wavelength and ρ the number of particles per unit volume. The discussion of the coefficient, I, and its evaluation for various systems is the main object of the paper. It is based on an extension to general systems of particles of Ewald's method for the calculation of lattice sums. For any system, I is found to be smaller than 3. It remains very near to this value for all systems not too far removed from conditions of close packing. The cases of ideal lattices, real crystals with thermal disorder, and liquids are treated in detail. (auth)

4582

ENERGY LOSS OF FAST ELECTRONS IN PASSING THROUGH FOILS (MULTIPLE SCATTERING). Walter Schultz. Z. Physik 129, 530-46(1951) Apr. 28. (In German)

Using a method given by Landau (J. Physics U.S.S.R. 8, 201(1944)) an integro-differential equation for the distribution function of decelerated electrons is derived, from which, through a Fourier transformation, an integral form of the distribution function is obtained. The integral is evaluated by approximation, the excitation, ionization, and bremsstrahlung being taken into account. While for a 2.8-Mev primary energy the results agree with measurements of Paul and Reich (Z. Physik 127, 429(1950)), for a 4.7-Mev impinging energy the experimental curves are notably wider than the calculated ones. It is found also that Paul and Reich's data confirm the value of Fermi's correction for the effect of the polarization of the scattering medium on the energy loss. (auth)

4583

ON SOME RECENT CALCULATIONS ON CASCADE SHOWER THEORY. H. Messel. Phys. Rev. 82, 259-60 (1951) Apr. 15. (Letter to the editor)

This letter is concerned with the solution of the diffusion equations of the cascade theory of electron showers when the ionization loss term is included. It is a defense of the simple series solution of Bhabha and Chakrabarty (Phys. Rev. 74, 1352(1948)) against the much more tedious solution of Snyder (Phys. Rev. 76, 1563(1949)) and Bernstein (Phys. Rev. 80, 995(1950)).

4584

PROTON-PROTON SCATTERING AT 5 MEV. K. B. Mather. Phys. Rev. 82, 133-40(1951) Apr. 15.

A scattering chamber has been constructed which employs a number of radial slit units arranged at various angles with respect to the collimated beam of protons. A photographic plate is placed behind each slit unit and the tracks of protons which are scattered into the plate can be counted. To obtain cross sections from this apparatus the number of tracks per unit area must be determined. Protons were scattered from hydrogen gas at approximately 1.5-cm Hg pressure. Advantages of the design were relatively simple geometry, data obtained simultaneously at all angles, almost complete freedom from impurity-scattering, and short cyclotron-running times. The differential cross sections were measured for 5.07-Mev protons from 14 to 150° in the center-of-mass system. The results indicate an S-wave phase shift of $54.5 \pm 0.6°$ and a repulsive P-wave phase shift of $0.05 \pm 0.09°$. (auth)

4585

RELATIVISTIC CORRECTIONS IN HIGH ENERGY n-p SCATTERING. Armand Siegel. Phys. Rev. 82, 194-203 (1951) Apr. 15.

A method, due to Breit (Phys. Rev. 53, 153(1938)), of generalizing phenomenological nuclear interactions to give a relativistically invariant cross section in the first Born approximation, has been extended to apply to a broad class of nonrelativistic interactions; namely, those containing isotopic spin operators and any kind of Pauli spin and space dependence. A procedure is given for obtaining an equivalent Pauli operator for the Dirac operators so obtained, which reduces the calculation of the relativistic cross section (in the first Born approximation), formally, to a nonrelativistic calculation. The cross section is then obtained in a form in which the relativistic corrections are explicitly split off from the nonrelativistic terms. The method is applied to the symmetric-exchange interaction with tensor forces. The form of the relativistic interaction is not uniquely determined by that of the nonrelativistic one, but a number of the more conservative possibilities are investigated. The corrections to the 90-Mev n-p scattering thus obtained are analyzed in relation to the data. The possibility of exploiting these corrections to adjust the theory to experiment is discussed. (auth)

4586

Bartol Research Foundation, Franklin Inst.

THE SCATTERING OF FAST NEUTRONS BY BISMUTH AND LEAD. C. E. Mandeville and C. P. Swann. [nd] 16p. (NEPA-1656)

Homogeneous fast neutrons of energy 4.3 Mev, supplied by the d-d reaction in the Bartol van de Graaff statitron, have been scattered in Bi and Pb, and 50,000 fields of view were examined on the Eastman NTA plates to obtain 5,000 acceptable recoil proton tracks. From a consideration of gross effects, it is concluded that no inelastic group exists in the Bi data with an intensity greater than 5% of the elastically scattered neutrons, or that no level in Bi^{209} lying between the ground state and 3.4 Mev is excited by a neutron group of more than 5% of the intensity of the elastic group. Appreciable inelastic scattering was noted in naturally occurring Pb, the inelastic scattering cross section being less than half the elastic cross section. The energy distribution of the inelastically scattered neutrons is interpreted to indicate energy levels in Pb in the vicinity of 1.3 Mev and 3.3 Mev. Alternative interpretations of the data for Pb are discussed in an appendix. (auth)

4587

SCATTERING OF NEUTRONS BY DEUTERONS AT LOW ENERGIES. A. Troesch and M. Verde. Helv. Phys. Acta 24, 39-48(1951) Feb. 15. (In German)

The elastic scattering of neutrons by deuterons reveals the exchange character of the interaction between nucleons better than does the nucleon-nucleon scattering. However, numerical calculations of the scattering phases in the neutron-deuteron process, considered as a three-body problem, is relatively simple only in the case of high-energy neutrons. It is shown how the three-body problem can be conveniently extended to low-energy neutrons by a procedure recently used by Bethe (Phys. Rev. 76, 38(1949)) in the treatment of the two-body problem. At low energies the P wave is very feebly scattered, so that its observed effect is due to the interference with the S wave; consequently, a fair approximation is sufficient in the computation of the δ_1 scattering phases, an exact calculation being required only for the δ_0 phase of the S wave. The system's eigenfunction for zero energy of the impinging neutron is obtained by a variation method. The problem is worked out for potentials given both by the symmetrical and the neutral meson theories.

4588

THE SCATTERING OF PROTONS BY TRITONS. R. S. Claassen, R. J. S. Brown, G. D. Freier, and W. R. Stratton. Phys. Rev. 82, 589-96(1915) June 1.

The differential cross section for the scattering of protons by tritons has been measured in the angular range of 41.85 to 163° in the laboratory (54.7 to 168.7° in the center-of-mass system) at five energies between 2.54 and 3.50 Mev using protons from the Minnesota electrostatic generator. A small-volume (42 cc) scattering chamber with an angular range of 17 to 163° was used for these measurements. Measurements of proton-proton and proton-helium cross sections and a comparison of the results with those obtained previously with a large scattering chamber showed that this small chamber gave results too high (about 3%) at the low scattering angles. These measurements determined a correction which was applied in the calculation of the p-T cross sections from the experimental data. The center-of-mass differential cross section varies between a maximum of 0.243×10^{-24} cm²/unit solid angle at 54.7° and 3.5 Mev and a minimum of 0.065×10^{-24} cm⁻²/unit solid angle at 109.5° and 3.5 Mev in the angle and energy range studied. The cross sections considered as a function of angle display a strong minimum, near 100°, in the center-of-mass coordinate system. The cross section for a given angle is a slowly varying function of energy. (auth)

RADIATION EFFECTS

4589

North American Aviation, Inc.

A THEORETICAL ESTIMATE OF THE EFFECT OF RADIATION ON THE ELASTIC COEFFICIENTS OF SIMPLE METALS. G. J. Dienes. June 20, 1951. 19p. (NAA-SR-80)

Radiation damage is considered to be the result of the formation of interstitial atoms and lattice vacancies by the high energy incident particles. An approximate theoretical treatment is given of the change in elastic constants of simple metals caused by the presence of a given (small) fraction of interstitial atoms and vacancies. The elastic coefficients are calculable from the atomic interaction potentials. For Na it was necessary to take into account both attractive and repulsive energies, which was accomplished by the use of a Morse potential function, while for Cu it has been found sufficient to use a simple exponential repulsive interaction. In both cases, the presence of a small fraction of interstitials and vacancies results in large increases in the elastic coefficients, the change being proportional to the fraction of displaced atoms. It is shown that lattice vacancies alone always decrease the elastic coefficients, the change being essentially a bulk effect. Consequently, increases in the elastic coefficients measure primarily the fraction of interstitial atoms. From this theoretical estimate it is concluded that the predicted effects should be easily measurable experimentally provided thermal annealing is prevented. Further, changes in elastic constants may serve as a useful and powerful tool for distinguishing between interstitial atoms and vacant lattice sites. (auth)

RADIOACTIVITY

4590

Brookhaven National Lab.

THE DECAY OF I^{125}. G. Friedlander and W. C. Orr. [nd] 13p. (AECU-1499)

The decay of I^{125} has been investigated. The nuclide decays entirely by orbital electron capture with a half life of 60.0 ± 0.5 days. An upper limit of 5×10^{-4} was set for the fraction of I^{125} decaying to the 58-day isomer of Te^{125}. By proportional-counter and coincidence measurements it was established that all transitions go to the 35.4-kev level of Te^{125}, which is a $d_{\frac{3}{2}}$ state. The I^{125} ground state can be assigned a $d_{\frac{5}{2}}$ configuration. The ratio of L_I to K electron capture was determined to be between 0.18 and 0.45, with a most probable value 0.30. From these ratios, the energy difference between the ground states of I^{125} and Te^{125} was found to be between 95 and 215 kev, with the most probable value 115 kev. The corresponding ft values for the transition to the 35.4-kev level of Te^{125} fall in the range of allowed transitions. (auth)

4591

Argonne National Lab.

HALF-LIFE AND ALPHA-PARTICLE ENERGY OF U^{236}. A. H. Jaffey, H. Diamond, A. Hirsch, and J. Mech. [nd] 6p. (ANL-WMM-661(rev.))

The recent preparation of U^{236} in concentrations of 22 to 37% by extensive neutron irradiation of U^{235} followed by electromagnetic separation has made possible more accurate measurements of the half life and α-particle energy of U^{236}. The determination of the U^{236} specific activity involved the measurement of the weight of U^{236} in each sample and the α-particle disintegration rate due to it. To determine the weight of U^{236}, relative concentrations of the U isotopes were measured by mass-spectrometric analysis,

and the absolute weight of U in each sample was determined indirectly by counting neutron-induced fissions. To determine the U^{236} α activity, collimated samples were measured in a grid-type ionization chamber associated with a 48-channel pulse height analyzer. Half-life values from 3 samples gave an average of 2.457×10^7 yr. The average of 9 measurements resulted in an α-particle energy value of 4.499 ± 0.004 Mev (mean deviation). (The original report was declassified as AECD-3026)

4592

Oak Ridge National Lab.

SHORT-PERIOD ACTIVITIES, sect. 3 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. E. C. Campbell. Mar. 15, 1951. 9p. (ORNL-940(sect. 3))

From internal-conversion measurements the 205-kev γ from erbium (2.5-sec) has been classified as (most probably) electric dipole or quadrupole, in serious conflict with the interpretation resulting from half-life data. β- and γ-ray studies in the decay of Ag^{108} have been made, and a decay scheme has been proposed. Confirmation of Siegbahn's assignment of the 24-sec period to the ground state of Ag^{110} has been obtained. (auth)

4593

Oak Ridge National Lab.

SHORT-LIVED ISOMERS, sect. 4 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. F. K. McGowan. Mar. 15, 1951. 5p. (ORNL-940(sect.4))

The half life of the isomeric state of Os^{189}, which emits a 137-kev γ, has been measured and found to be 8×10^{-10} sec. Both the half life and internal-conversion data are consistent with electric-quadrupole radiation. (auth)

4594

Oak Ridge National Lab.

INVESTIGATIONS WITH THE SCINTILLATION SPECTROMETER, sect. 5 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. P. R. Bell, J. M. Cassidy, R. C. Davis, and G. G. Kelley. Mar. 15, 1951. 11p. (ORNL-940(sect.5))

Long-lived Cadmium. The half life of the long-period activity in Cd^{113} has been measured. The new value, 3.5 ± 0.5 yr, necessitates a change in the activation cross section to 0.20 ± 0.01 barn. Iodine^{131}. Data from γ-γ and β-γ spectra lead to a consistent decay scheme with three β chains leading from I^{131} to the ground state of Xe^{131} via the emission of six γ rays. The Fermi plot for the β rays in coincidence with the high-energy γ rays after correction for 80-kev radiation, is fairly straight and gives an end point of 255 ± 10 kev. Hollow-crystal Spectrometer. Preliminary results obtained seem to promise satisfactory performance in reducing distortion due to extraneous radiation as well as reduction of scattering losses. (auth)

4595

THE BETA-SPECTRUM OF Cl^{36}. H. W. Fulbright and J. C. D. Milton. Phys. Rev. 82, 274(1951)) Apr. 15. (Letter to the editor)

The Cl^{36} β spectrum has been examined by use of a high-pressure argon-filled proportional counter. It is concluded that it may well be possible to account for the shape of the spectrum by means of a single interaction 2T (or 2V).

4596

COMPLEX SPECTRA. C. J. Bakker. Nederland. Tijdschr. Natuurk. 17, 131-42(1951) Apr. (In Dutch)

A discussion of principal features of β emissions and K captures, both with and without accompanying γ radiations, is presented. 25 references.

4597

A CONTRIBUTION TO THE STUDY OF NUCLEAR DECAY SCHEMES. DISINTEGRATION OF As^{76} AND Mo^{99}. Nadine Marty-Wollman. Thesis, University of Paris, 1950. Paris, Masson et Cie, 1950. 70p. (In French)

The decay of As^{76} and Mo^{99} was investigated with the aid of a semicircular β-ray spectrometer. The energy of the two intensive γ emissions of As^{76} is 0.56 and 1.25 Mev, while the maximum energy of its β spectrum is 3.15 ± 0.03 Mev; the latter is composed of at least four partial spectra corresponding to various excited states of Se^{76}; the number of β^+ emitted does not exceed 0.5% of that of β^-. In the study of Mo^{99} in equilibrium with Tc^{99*}, γ rays of 745, 780, and 850 kev were measured; the maximum energy of the composite β spectrum is 1250 ± 15 kev; the transition of Tc^{99*} into the ground state is accompanied by a partially converted emission of a 139 ± 1-kev photon.

4598

DELAYED COINCIDENCE ANGULAR CORRELATIONS. Stuart P. Lloyd. Phys. Rev. 82, 277-8(1951) Apr. 15. (Letter to the editor)

A study is made of the directional correlation of successive particles emitted in the nuclear cascade $j_1 - j \rightarrow j_2$, where the j's are the angular momenta of the nuclear levels, when the source is placed in a constant homogeneous magnetic field. The delayed-coincidence angular correlation pattern is just the instantaneous pattern precessing with the intermediate nucleus around the external field.

4599

THE DISINTEGRATION OF As^{74}. Stig Johansson, Yvette Cauchois, and Kai Siegbahn. Phys. Rev. 82, 275(1951) Apr. 15. (Letter to the editor)

A detailed investigation of the 17.5-day activity of As^{74} has disclosed 2 β^- particles, 2 β^+ particles, and 2 γ rays. The high intensity line in the γ spectrum is emitted in the soft β^+ decay and the small intensity line in the soft β^- decay. The hard β^- and β^+ components are in the class of spectra of uniquely forbidden shape. A disintegration scheme satisfying the data is presented.

4600

THE DISINTEGRATION OF Nd^{147}. W. S. Emmerich and J. D. Kurbatov. Phys. Rev. 83, 40-43(1951) July 1.

Three groups of monochromatic electrons corresponding to gamma-rays of 91.5 ± 1.0 kev, 320 ± 3 kev, and 534 ± 4 kev have been identified in the disintegration of Nd^{147}. These gamma-rays are ascribed to transitions in Pm^{147}. Evidence has been obtained for a complex beta-spectrum of Nd^{147}. On the basis of coincidences, a partial scheme of disintegration for Nd^{147} is proposed. The total energy decrease from the ground state of Nd^{147} to the ground state of Pm^{147} nuclei is 1.425 ± 0.015 Mev. (auth)

4601

DISINTEGRATION SCHEME OF Re^{186}. Franz R. Metzger, and R. D. Hill. Phys. Rev. 82, 646-50(1951) June 1.

The radiations from Re^{186} have been studied by means of β-ray spectrometers and scintillation counting techniques. It has been found that Re^{186} decays both by β emission and by K capture. Three partial β-ray spectra of 1.07-, 0.93-, and 0.3-Mev maximum energies have abundances of 76, 19, and 0.4%, respectively, and lead to the ground state and 137- and 627-kev excited states of Os^{186}. Two K-capture branches of 3 and 2% abundances lead to the ground state and a 123-kev excited state of W^{186}. Transitions between these states give rise to electric quadrupole γ rays of 137 and 123 kev and other relatively weak magnetic dipole γ rays of 764- and 627-kev energy. A decay scheme in which spins and parities are assigned to all the levels is proposed. (auth)

4602
ENERGY LEVELS IN Li^7. H. E. Gove and J. A. Harvey. Phys. Rev. 82, 658-63(1951) June 1.

The following reactions which show a new level in Li^7 at the listed excitation energy have been studied using protons, deuterons, and alphas of energies 7.9, 14, and 31 Mev, respectively, from the MIT cyclotron:

$Li^7(p,p')Li^{7*}$	$E_x = 4.67 \pm 0.08$ Mev
$Li^7(\alpha,\alpha')Li^{7*}$	$E_x = 4.79 \pm 0.22$ Mev
$Li^7(d,d')Li^{7*}$	$E_x = 4.86 \pm 0.15$ Mev
$Be^9(d,\alpha)Li^{7*}$	$E_x = 4.76 \pm 0.15$ Mev
	Mean $E_x = 4.77 \pm 0.10$ Mev

In all cases the differential range spectra of the emitted groups were measured in Al absorbers using a gated triple proportional counter. In addition, a low energy group was found in the $Be^9(d,\alpha)$ reaction which would correspond to a level in Li^7 at 7.50 ± 0.17 Mev. No corresponding group was observed in the inelastic scattering reactions. Possible explanations of this are given. Preliminary results on the $Li^7(d,t)Li^{8*}$ and the $Li^8(p,p')Li^{8*}$ reactions indicate a level in Li^8 at 2.15 ± 0.2 Mev. There is also evidence for two levels in Li^8 at excitation energies of 1.0 ± 0.2 and 2.3 ± 0.2 Mev from the $Li^7(d,p)Li^{8*}$ reaction. (auth)

4603
THE 43-DAY ISOMER OF CADMIUM (115). P. S. Gill, C. E. Mandeville and E. Shapiro. Indian J. Phys. 24, 566-70(1950) Dec.

The 43-day activity of Cd^{115} was induced in pure metallic cadmium irradiated by slow neutrons in the Oak Ridge pile. After chemical purification, the radiations were analyzed with the utilization of conventional absorption and coincidence techniques. It is concluded that the 43-day activity decays with the emission of β rays of energy 1.41 Mev and at least two γ rays having, respectively, energies of 0.10 and 1.10 Mev. These γ rays are coincident with an inner β spectrum having an end point at approximately 0.38 Mev. The β-γ coincidence data show that only 0.85% of the total β radiation is contained in the softer group. γ-γ coincidences indicate cascade emission of γ rays. (auth)

4604
FURTHER SEARCH FOR NUCLEAR TRANSITIONS WITH LIFETIMES BETWEEN 3×10^{-9} SEC AND 10^{-7} SEC. W. E. Wright and M. Deutsch. Phys. Rev. 82, 277(1951) (Letter to the editor)

The method of delayed coincidences has been utilized in a search for nuclear metastable states with lifetimes less than 10^{-7} sec. Eight transitions with half lives $< 5 \times 10^{-9}$ sec are tabulated.

4605
INVESTIGATION OF THE γ RAYS FROM POLONIUM. M. A. Grace, R. A. Allen, D. West, and H. Halban. Proc. Phys. Soc. (London) 64A, 493-507(1951) May.

A method of standardizing Po sources by measurement of the number of γ rays is described. The hard γ radiation of 0.773 Mev energy emitted in the decay of Po^{210} has been found to have an intensity of $1.8 \pm 0.14 \times 10^{-6}$ quanta per α particle. The internal conversion of this line to the extent of $6.7 \pm 1.7\%$ gives rise to K x radiation of lead. No other soft radiation was detected. The decay scheme of Po is discussed. (auth)

4606
LIFETIME OF BETA EMITTERS. C. C. Jonker. Nederland. Tijdschr. Natuurk. 17, 105-18(1951) Apr. (In Dutch)

A review of methods for the determination of half lives of β emitters is followed by a discussion of semiempirically found correlations between various aspects of the β radiation. 36 references.

4607
MIRROR LEVELS IN Li^7 AND Be^7. Ben R. Mottelson. Phys. Rev. 82, 287(1951) Apr. 15. (Letter to the editor)

The recently discovered (Brown, et al., Phys. Rev. 78, 88(1950)) level in Be^7, which appears to be the mirror level of the well-known 478-kev level in Li^7, has an excitation of 429 kev above the ground state. Shifts of just the magnitude of that observed in Li^7-Be^7 can occur as a result of the electromagnetic spin-orbit interaction. The effect of electromagnetic interactions has been calculated assuming 3 different coupling schemes.

4608
NATURAL SPREAD OF THE CONIC DISTRIBUTION OF THE ČERENKOV RADIATION. Yin-Yuan Li. Phys. Rev. 82, 281(1951) Apr. 15. (Letter to the editor)

This note is written to correct an error in a previous letter (Phys. Rev. 80, 104(1950)) in which the author overestimated the natural spread of the Cherenkov radiation. The coherent path length of an electron is much closer to the actual length of travel in the material than it is to the mean free path between emissions of quanta.

4609
THE NONCENTRAL ELECTRIC INTERACTION IN ALPHA-RADIOACTIVITY. Melvin A. Preston. Phys. Rev. 82, 515-20(1951) May 15.

Apart from the penetrability of the coulomb potential barrier, which determines the order of magnitude of the intensity of α decay, there are three secondary effects which alter the decay constant: angular momentum, "formation" prohibition as discussed by Perlman, Ghiorso, and Seaborg (Phys. Rev. 77, 26(1950)), and noncentral electric interaction with the product nucleus. The general theory of this last effect is discussed and its magnitude estimated. It is suggested that it may be of considerable importance in determining the intensity of highly forbidden ground-state transitions described by Perlman, Ghiorso, and Seaborg. Numerical calculations are made for a typical dipole case. (auth)

4610
NUCLEAR SPECTROSCOPY OF Ba^{131} AND Cs^{131}. Robert Canada and Allan C. G. Mitchell. Phys. Rev. 83, 76-9(1951) July 1.

The spectra of Ba^{131} and Cs^{131} have been investigated in a magnetic lens spectrograph. The 12-day Ba^{131} decays by orbital electron capture. Gamma-rays at 0.497, 0.371, 0.241, 0.213, 0.196, and 0.122 Mev have been observed. Cs^{131} (10-day) decays entirely by orbital electron capture. No gamma-rays are associated with this transition. In the particle spectrum only Auger electrons are found. There are no internal conversion lines which could arise from the 0.080- and 0.163-Mev states of Xe^{131}. It is concluded that Cs^{131} decays to the ground state of Xe^{131}. (auth)

4611
ON ALPHA-DISINTEGRATION: PART I SOME USEFUL THEORETICAL TABULATIONS AND GRAPHICAL PLOTS. Ranjit Kumar Das. Indian J. Phys. 24, 523-38(1950) Dec.

Starting from the Bethe-Weizsaker (Revs. Modern Phys. 8, 165(1936)) mass defect formula an expression has been deduced for the total energy released in an α disintegration. The calculation has been confined to groups of nuclides with, I = 44, 45, 46, 47, 48, 49, 50, 51, 52, and 54. Useful theoretical data are given in ten tables. β, γ, δ, and Q curves are plotted on ten separate groups and their outstanding characteristics briefly discussed. (auth)

4612
ON THE DISINTEGRATION OF SCANDIUM (46) AND THE METHOD OF DELAYED COINCIDENCE FOR THE STUDY OF SHORT-LIVED METASTABLE STATES IN ISOMERIC NUCLEI. B. D. Nag, S. Sen, and S. Chatterjee. Indian J. Phys. 24, 479-96(1950) Nov.

A metastable state having a half life of 12.15 ± 0.2 microseconds has been found in Ti^{46} decaying from 85-day Sc^{46}. The method of delayed coincidence used for the purpose has been discussed with reference to the effect of time-lag in G-M counters. The distribution function for the time-lag is found to differ from the Gaussian error function. A mathematical expression relating the decay constant of the metastable state to the delay in one of the channels has been derived. The disintegration scheme of Sc^{46} has been examined. (auth)

4613
ON ILLUSTRATING THE REGULARITY OF ALPHA-RADIOACTIVITY. F. W. Van Name, Jr. Am. J. Phys. 19, 230-2(1951) Apr.

The regularity of α radioactivity is usually illustrated by the Geiger-Nuttall Law. Guided by the quantum-mechanical solution of the problem of α-particle emission, a way of plotting these data is shown, which yields a more satisfactory straight line than the Geiger-Nuttall plot. Log λ is plotted against $(Z-2)/v_c$ where λ = disintegration constant, Z = atomic number of emitter, and v_c = velocity of α particle relative to the nucleus. (auth)

4614
ON THE RADIOACTIVITY OF Cr^{55}. P. Jordan, P. Scherrer, and W. Zünti. Experientia 7, 134-5(1951) Apr. 15. (In French)

The β activity of Cr^{55}, although reported by several authors, could not be observed by means of the reaction $Mn^{55}(n,p)Cr^{55}$ using Li-D neutrons. This negative result can be explained either by a long half life (>100 yr), or by a a low radiation energy (<0.1 Mev), or else by a high-energy threshold of the reaction (n,p), which implies a radiation of about equal energy.

4615
ON THE THEORY OF BETA-RADIOACTIVITY IV. THE POLARIZATION OF BETA-RAYS EMITTED BY ALIGNED NUCLEI IN ALLOWED TRANSITIONS. H. A. Tolhoek and S. R. De Groot. Physica 17, 81-97(1951) Feb.

The consequences of alignment of nuclei which show allowed β-transitions are investigated. A general formula is derived for the transition probability of an allowed β-transition, in which the direction of emission of electron and neutrino, the polarization of the electron and the orientation of the nuclear spin are taken into account. The calculations have been made for a Hamiltonian for the β-interaction, which is an arbitrary "mixture" of the five invariants of the Dirac theory. The influence of the nuclear charge has, however, been neglected. From this formula the following results are immediately obtained:

The angular distribution of the β-radiation remains spherically symmetric if the nuclei are aligned, so that the alignment cannot be detected in this way.

The emitted β-radiation is polarized and the degree of polarization follows from the general formula. If we take the special case that the interaction Hamiltonian is of the tensor or the axial vector type and if the β-rays are emitted perpendicular to the direction of the nuclear spin of completely aligned nuclei with nuclear spin j_i, the degree of polarization is given by: a) $1/E$, if $j_i = j_f + 1$, b) $1/E(j_i+1)$, if $j_i = j_f$, c) $j_i/E(j_i+1)$, if $j_i = j_f - 1$. (E is the relativistic energy of the electrons, $E \approx 1$ for small kinetic energies; j_f gives the spin of the final nucleus). (auth)

4616
THE RADIATIONS OF UY (^{231}Th). P. H. Stoker, Ong Ping Hok, and G. J. Sizoo. Physica 17, 164-6(1951) Feb. (Letter to the editor)

The $\beta\gamma$-ray spectrum of UY (Th^{231}) has been measured in a 180° magnetic spectrometer. Natural uranium being the starting material, the UX_1 spectrum from the decay of U^{234} was also present and had to be subtracted from the superimposed UY-UX_1 spectrum. The energy levels of the Pa atom, to which the conversion lines of UY have been ascribed, are represented in a table. From these data it may be concluded that at least the three γ rays of 59, 63, and 82 kev are emitted in the decay of UY, and indications of other conversion lines were found.

4617
RADIOACTIVE Hg^{203} AND Hg^{205}. W. S. Lyon. Phys. Rev. 82, 276(1951) Apr. 15. (Letter to the editor)

Previous assignments (H. Slätis and K. Siegbahn, Phys. Rev. 75, 318(1949)) of the 46-day Hg activity to Hg^{203} and the 5 min activity to Hg^{205} have been verified. The radiation from Hg^{205} has been studied, and the thermal neutron activation cross sections for the reactions $Hg^{202}(n,\gamma)Hg^{203}$ and $Hg^{204}(n,\gamma)Hg^{205}$ with pile neutrons determined. For production of Hg^{203}, σ(isotopic) = 3.8 and σ(atomic) = 1.1 barns; for Hg^{205}, σ(isotopic) = 0.47 and σ(atomic) = 0.032 barns.

4618
RADIOACTIVITY INDUCED IN IRIDIUM BY NEUTRON CAPTURE. J. M. Cork, J. M. LeBlanc, A. E. Stoddard, W. J. Childs, C. E. Branyan, and D. W. Martin. Phys. Rev. 82, 258-9(1951) Apr. 15. (Letter to the editor)

With the increased neutron flux of the Argonne pile, a source of much higher specific activity has now been obtained and found to yield many previously unobserved electron lines in Ir^{192}. The 45 electron lines observed in the energy range from 49 to 600 kev are tabulated with their relative intensities, interpretation, and γ energy. A nuclear energy level scheme for Pt^{192} and Os^{192} is proposed.

4619
THE TWICE-FORBIDDEN TRANSITION OF Cs^{137} AND THE LAW OF BETA-DECAY. L. M. Langer and R. J. D. Moffat. Phys. Rev. 82, 635-8(1951) June 1.

The shape of the β spectrum of the direct 1.17 Mev, 8% abundant transition between the $g_{7/2}$ ground state of Cs^{137} and the $d_{3/2}$ ground level of Ba^{137} has been studied in detail in a magnetic spectrometer. The shape of the spectrum can be adequately described by a twice-forbidden factor, C_{2T}, resulting from the tensor form of interaction. Neither the axial vector form nor the combination S−A−P are capable of accounting for the data. (auth)

SPECTROSCOPY

4620
ABSORPTION SPECTRA OF THALLIUM HALIDES. P. Tiruvenganna Rao. Indian J. Phys. 24, 434-40(1950) Oct.

The absorption spectra of TlI, TlCl, and TlBr have been investigated in the region 6500 to 2200 A. An examination of the new absorption photographs obtained for TlI in the present work, has led to an important modification in the analysis of the main system $^3\Pi - {}^1\Sigma^+$, reported earlier in emission. The origin had to be located at ν 26339.6 instead of at ν 25780.0 and the vibrational quantum numbers v′ and v′′ had to be increased by 11 and 13 units, respectively. The revised vibrational constants are: ω_e' = 93.4, ω_e'' = 123.5, ν_e = 26361.7, $\chi_e'\omega_e'$ = 0.10, and $\chi_e''\omega_e''$ = 0.09. No systems of TlI attributable to the transitions $^3O^+ - {}^1\Sigma^+$ AND and $^1\Pi - {}^1\Sigma^+$ have been obtained in absorption. The two systems of TlCl lying between 4200 to 3800 A and one for

TlBr in the region around 3950 A reported in emission have not occurred in absorption. (auth)

4621

THE ABSORPTION SPECTRUM OF SULFUR HEXAFLUORIDE IN THE VACUUM ULTRAVIOLET REGION. Ta-Kong Liu, George Moe, and A. B. F. Duncan. J. Chem. Phys. 19, 71-2(1951) Jan.

The spectrum of sulfur hexafluoride has been investigated down to wavelengths about 600 A. The maximum of the first electronic transition is found at about 1050 A. Three other transitions occur between this wavelength and 802 A, where strong continuous absorption begins, and nothing further can be resolved at shorter wavelengths. Qualitative suggestions are offered about the dissociation of SF_6 and the value of its ionization potential. (auth)

4622

THE BAND-SPECTRUM OF CARBON MONOFLUORIDE, CF. E. B. Andrews and R. F. Barrow. Proc. Phys. Soc. (London) 64A, 481-92(1951) May.

Measurements of two band systems attributed to CF are reported. A rotational analysis of four bands, 1,0, 0,0, 0,1 and 1,1, of a transition $A^2\Sigma^+ - X^2\Pi$ is given, and the vibrational analysis of a system B (near case b) $- x^2\Pi$. The rotational constants of the B state have been estimated from band-head separations. $X^2\Pi$ is probably the ground state of CF. The initial convergence of the vibrational levels in B is rather rapid, and suggests that D_0'' is about 4.9$_6$ ev. Constants derived are tabulated. 11 tables. (auth)

4623

Southern California Univ.

A CONSTANT INTENSITY SPECTROSCOPIC LIGHT SOURCE FOR THE VACUUM ULTRAVIOLET. (Technical Report No. 5) G. L. Weissler. Apr. 1951. 23p. (NP-3084)

A vacuum spectroscopic light source has been developed which furnishes a constant intensity emission line spectrum. Reproducibility was achieved by controlling with an oscilloscope the spark breakdown potential and the number of breakdowns per cycle of the applied high voltage. The gas composition in the source was found to be critically important. The constancy was checked photometrically and found to be about 2%. (auth)

4624

THE INFRARED AND RAMAN SPECTRA OF SiF_4. E. A. Jones, J. S. Kirby-Smith, P. J. H. Woltz, and A. H. Nielsen. J. Chem. Phys. 19, 242-5(1951) Feb.

The infrared and Raman spectra of SiF_4 have been completely reexamined and extended. The Raman spectrum yields four lines at 268 cm^{-1}, 390 cm^{-1}, 800 cm^{-1}, and 1010 cm^{-1}, which have been assigned ν_2, ν_4, ν_1, and ν_3, respectively. In the infrared measurements, both prism and grating spectrometers were utilized. Several bands reported in earlier work have been ascribed to impurities and nine new bands have been observed and identified. The long-wave ν_4 at 391 cm^{-1} has been observed with a KRS-5 prism and its envelope determined. Bands involving ν_3 appear to have a PR spacing of about 12 cm^{-1} while those involving ν_4 appear to have a PR spacing of about 20 cm^{-1}. (auth)

4625

INVESTIGATIONS OF THE BAND-SPECTRUM OF BERYLLIUM OXIDE. Albin Lagerqvist. Thesis, Univ. of Stockholm, 1948. 98p. (See also NSA 1-1947)

Chapter I. The band system $\Sigma^+ - \Sigma$ is analyzed rotationally in detail. A calculation of the intensity distribution of the bands is given. Chapter II. The infrared $\pi - \Sigma$ system is investigated from λ 5900 A up to λ 11600 A. Chapter III. The $\Sigma^+ - \Pi$ inter-combination system is treated. The structures of some bands are given, and some $\Pi\ \Sigma^+$ perturbations are shown. Chapter IV. The perturbing matrix elements for some of the $\Pi\ \Sigma^+$ and $\Sigma\ \Pi$ perturbations are calculated. The intensity distribution of some perturbed split lines is investigated. For this purpose a rough determination of the temperature in the Be arc is made. Chapter V. The complicated ultra-violet bands are investigated. A new modification of Harvey and Bell's singlet Π-Π system assuming that the bands contain Q-branches is suggested. The existence of triplet bands is shown, and an attempt is made to arrange the triplet heads in an equation. Chapter VI. The correlation between the molecular states of BeO and the separated atoms is discussed. (auth)

4626

NEW MEASUREMENTS ON THE INFRARED SPECTRUM OF OF_2. E. A. Jones, J. S. Kirby-Smith, P. J. H. Woltz, and A. H. Nielsen. J. Chem. Phys. 19, 337-9(1951) Mar.

The infrared spectrum of F_2O has been reexamined from 2 to 25 μ with a prism spectrometer and selected regions further examined with a grating spectrometer. Several bands observed by Hettner, Pohlmann, and Schumacher (Z. Physik 96, 203(1935)) have been shown to be caused by impurities. Other bands observed by them have been resolved, and an assignment of fundamental modes has been made which is consistent with dimensions of the molecule obtained from electron diffraction data. Two new bands have been observed and assigned to combinations of the fundamentals. The present observed frequencies and their assignments are: ν_1 = 928 cm^{-1}, ν_2 = 461 cm^{-1}, ν_3 = 831 cm^{-1}, $\nu_1 + \nu_3$ and $2\nu_2 + \nu_3$ at 1731 cm^{-1}, $3\nu_3$ = 2460 cm^{-1}, $2\nu_1 + \nu_2$ = 2643 cm^{-1}. (auth)

4627

ON THE BAND SPECTRA OF THE HYDRIDES AND DEUTERIDES OF Cu, Ag, Au, Al. Bengt E. Nilsson. Thesis, Univ. of Stockholm, 1948. 54p.

The band spectrum of CuH has been investigated with a water-cooled hollow cathode according to Schüler (H. Schüler and H. Gollnow, Z. Physik 93, 611(1935)). The experimental results speak in favor of the assumption that predissociation occurs. The band spectrum of CuD has been exposed with the same source of light and showed a normal course in respect to intensity. An investigation with a hollow cathode with Au and Ag insets on the band spectra of Ag and Au hydride and deuteride has also been undertaken. Here, too, the distribution of intensity is normal. At the AlD bands $\pi - {}'\Sigma$ with the 0 − 0 band at λ 4240, a pressure-effect similar to that at AlH λ 4240 has been shown. The AlH bands λ 2033 and λ 1887 have been investigated both in emission and absorption. The AlH band λ 2229 has been exposed with a 21-ft grating. The AlH and AlD spectra have been investigated with a hollow cathode as the source of light. In the AlH band λ 4240 a marked breakoff in the rotation-structure appeared at J = 18. The two last P lines showed a fall in intensity. (auth)

4628

THE VIBRATIONAL SPECTRA OF DIBORANE AND SOME OF ITS ISOTOPIC DERIVATIVES. R. C. Lord and E. Nielsen. J. Chem. Phys. 19, 1-10(1951) Jan.

The infrared spectra of ordinary diborane, of $B_2^{10}H_6$, and of $B_2^{10}D_6$ have been determined in the vapor state over the spectral range 250 to 3800 cm^{-1}. The Raman spectra of ordinary diborane and $B_2^{10}D_6$ have been measured in the liquid at −130°C. Qualitative depolarization measurements have been made on nearly all observed Raman lines. The vibrational spectra have been interpreted with the help of the various selection rules and the product rule for isotope

shifts. The fundamental frequencies obtained from this interpretation differ considerably from those previously published but are in agreement with a large amount of spectroscopic data, including much not hitherto available. It is concluded that the nonplanar bridge model (D_{3h} symmetry) fits the spectroscopic data best, although the unsymmetrical C_{2h} form cannot be definitely excluded. The theoretical and observed vapor heat capacities agree satisfactorily over the temperature range 100 to 300°K. (auth)

THEORETICAL PHYSICS

4629

Nuclear Development Associates, Inc.

ANOTHER INVERTIBLE PIECEWISE GREULING SOLUTION TO THE STRAIGHT AHEAD TRANSPORT EQUATION. J. Ernest Wilkins, Jr. and Alan Oppenheim. Apr. 9, 1951. 13p. (NYO-638)

The straight ahead transport equation

$$\frac{\partial F(x,E)}{\partial x} + \mu(E)F = \int_E^{E_0} K(t,E)F(x,t)dt + K(E_0,E)e^{-\mu(E_0)x}$$

has been considered under the hypothesis of separability, i.e., $K(t,E) = G(t)H(E)$. It has been assumed in addition that the interval $(0,E_0)$ can be partitioned into a finite number of subintervals $(E_{n+1} < E < E_n)$ $(n = 0, 1,\ldots,N)$ such that on each of these intervals $K(E,E)$ may be closely approximated by some constant multiple of $d\mu/dE$, i.e., $K(E,E) = \alpha_n \frac{d\mu}{dE}$, $(E_n < E < E_{n-1})$. In an earlier report (NYO 633, NSA 5-736) the solution of the equation in question was discussed under various circumstances; one of which was that: (i) a_n is a finite integer $(n = 1,\ldots,N)$, $\alpha_{N+1} = -\frac{1}{2}$, $0 < a_1 < \ldots \alpha_N$. In this report the following case is discussed which generalizes case (i): (ii) α_n is a finite integer $(n = 1,\ldots N)$, $\alpha_{N+1} = -\frac{1}{2}$, $0 < \alpha_1 < \ldots < \alpha_p$, $\alpha_{p+1} < \cdots < \alpha_N < 0$. When $p \neq N$, the solution will involve the function $G(k,v) \int_0^v e^{-u} I_0(ku)du$, the properties of which are also discussed.

4630

Oak Ridge National Lab.

THEORETICAL PHYSICS, sect. 9 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 20, 1950; PHYSICS DIVISION. M. E. Rose and T. A. Welton. Mar. 15, 1951. 7p. (ORNL-940(sect.9))

A simple and admittedly crude model has been used in an attempt to account for γ-ray widths as observed in slow-neutron resonances. The widths as calculated for magnetic dipole and electric quadrupole are in reasonable agreement with observations but the electric-dipole widths are too large by a factor of about 10^8. This would be understandable if for some reason electric-dipole emission could not occur. The problem of possible restrictions on the β-decay interaction has been studied with the following results: (1) The symmetry in the $\beta^{\pm}$ spectra in the absence of a Coulomb field is automatically ensured by the Lorentz invariance of the β-decay Hamiltonian and does not have to be postulated ad hoc as was done by Tolhoek and De Groot (Physica 16, 456(1950)); and (2) the restriction on the choice of interactions made by Tolhoek and De Groot has no real foundation and is unnecessarily restrictive. The elastic scattering of atoms by atoms has been set up as a classical orbit calculation. Numerical work is in progress. (auth)

4631

THE FACTORIZATION METHOD. L. Infeld and T. E. Hull. Revs. Modern Phys. 23, 21-68(1951) Jan.

The factorization method is an operational procedure which enables one to answer, in a direct manner, questions about eigenvalue problems which are of importance to physicists. The underlying idea is to consider a pair of first-order differential-difference equations which are equivalent to a given second-order differential equation with boundary conditions. For a large class of such differential equations the method enables one to find immediately the eigenvalues and a manufacturing process for the normalized eigenfunctions. These results are obtained merely by consulting a table of the six possible factorization types. The manufacturing process is also used for the calculation of transition probabilities. The method is generalized so that it will handle perturbation problems. (auth)

4632

NONSTATIC SOLUTIONS OF EINSTEIN'S FIELD EQUATIONS FOR SPHERES OF FLUIDS RADIATING ENERGY. P. C. Vaidya. Phys. Rev. 83, 10-17(1951) July 1.

The energy tensor for a mixture of matter and outflowing radiation is derived, and a set of equations following from Einstein's field equations are written down whose solutions would represent nonstatic radiating spherical distributions. A few explicit analytical solutions are obtained, which describe a distribution of matter and outflowing radiation for $r \leq a(t)$, an ever-expanding zone of pure radiation for $a(t) \leq r \leq b(t)$ and empty space beyond $r = b(t)$. Since $db(t)/dt$ is almost equal to 1 and $da(t)/dt$ is negative, the solutions obtained represent contracting distributions, but the contraction is not gravitational because m/r is a constant on the boundary $r = a(t)$, m being the mass. The contraction is a purely relativistic effect, the corresponding newtonian distributions being equilibrium distributions. It is hoped that the scheme developed here will be useful in working out solutions which would help in a clear understanding of the initial or the final stages of stellar evolution. (auth)

4633

A NOTE ON DIRAC CENTRAL FIELD WAVE FUNCTIONS. M. E. Rose. Phys. Rev. 82, 389-91(1951) May 1.

A systematic treatment is developed for the discussion of the solution of the Dirac wave equation for a central field for the purposes of theories involving the finite size of the nucleus. (auth)

4634

ON GAUGE INVARIANCE AND VACUUM POLARIZATION. Julian Schwinger. Phys. Rev. 82, 664-79(1951) June 1.

This paper is based on the elementary remark that the extraction of gauge invariant results from a formally gauge invariant theory is ensured if one employs methods of solution that involve only gauge covariant quantities. This statement is illustrated in connection with the problem of vacuum polarization by a prescribed electromagnetic field. The results obtained for constant (that is, slowly varying fields), are then applied to treat the two-photon disintegration of a spin zero neutral meson arising from the polarization of the proton vacuum. Approximate, gauge invariant expressions are obtained for the effective interaction between the meson and the electromagnetic field, in which the nuclear coupling may be scalar, pseudoscalar, or pseudovector in nature. The direct verification of equivalence between the pseudoscalar and pseudovector interactions only requires a proper statement of the limiting processes involved. For arbitrarily varying fields, perturbation methods can be applied to the equations of motion, as discussed in Appendix A, or one can employ an expansion in powers of the potential vector. The connection between the proper-time method and the technique of "invariant regularization" is discussed. Finally, as an application of the Green's function for a constant field, the

author constructs the mass operator of an electron in a weak, homogeneous external field, and derives the additional spin magnetic moment of $\alpha/2\pi$ magnetrons by means of a perturbation calculation in which proper-mass plays the customary role of energy. (auth)

4635
OVERLAPPING DIVERGENCES AND THE S-MATRIX. Abdus Salam. Phys. Rev. 82, 217-27(1951) Apr. 15.

By extending considerations given by Dyson (Phys. Rev. 75, 1736(1949)), general rules are obtained for isolating divergent parts from integrals corresponding to overlapping graphs, and a proof is obtained for the appearance of an extra factor Z_1^{-1} from "b divergences." In the last section the possibility of renormalization for scalar meson-nucleon interactions is demonstrated. (auth)

4636
PARTICLE SPIN AND ROTATION. Nathan Rosen. Phys. Rev. 82, 621-4(1951) June 1.

It is proposed to treat the spin of a particle phenomenologically by considering the particle as a small rotating sphere, the rotation of which is described by euler parameters. If the rotation is quantized in the space of the euler parameters, one obtains both integral and half-integral values for the spin. In this way one arrives at a formalism in which the spin components can be represented as differential operators in the Schroedinger representation. (auth)

4637
QUANTUM STATISTICS OF FIELDS. A. E. Scheidegger and C. D. McKay. Phys. Rev. 83, 125-31(1951) July 1.

Gibb's theory of ensembles of classical mechanical systems has been modified for the application to quantum-mechanical systems by Klein. In this paper, the formalism of the latter author is applied to hamiltonians of different types of field theories and thus a consistent theory of field thermodynamics is obtained without explicitly referring to the statistical behavior of particles that are "contained" in the fields. Speaking in terms of particles, the thermodynamics obtained in this way is the same as for a mechanical system where only the temperature is known, but no other conditions such as the number of particles, the total charge, etc.

Specifically, the thermodynamic functions of the nonrelativistic and relativistic Schroedinger fields, Dirac's electron field, and the electromagnetic field are deduced. The statistics of the nonrelativistic fields correspond to ordinary Bose and Fermi statistics of an ensemble of identical particles; the relativistic cases, however, yield new expressions. The thermal equilibrium at low temperatures of the Dirac electron field turns out to be the "vacuum" state as described in the hole theory. Finally, it is also shown that the application of the present formalism to the electromagnetic field leads back to Planck's radiation theory. (auth)

4638
RENORMALIZATION OF THE MESON-PHOTON-NUCLEON INTERACTION. P. T. Matthews. Phil. Mag. (7) 42, 221-7(1951) Mar.

It is shown by direct calculation to fourth order in the coupling constants that all divergences, except those arising from the scattering of mesons by mesons, can be removed from the combined interaction of charged spinless mesons, nucleons (scalar interaction) and the electromagnetic field by mass and charge renormalization. The remaining divergence can be canceled to this order by assuming a direct interaction between mesons with a suitably chosen coupling constant. (auth)

4639
THE SOLUTION OF THE SCHRÖDINGER EQUATION FOR AN APPROXIMATE ATOMIC FIELD. Edward H. Kerner. Phys. Rev. 83, 71-5(1951) July 1.

An approximate atomic potential having an "effective nuclear charge for potential," that is, bilinear in the radial distance from the nucleus, is discussed and shown to approximate reasonably well to Hartree or Fermi-Thomas potentials. The Schroedinger equation with the approximate potential is solved as a series of hydrogenic wave functions and as a power series in $Ar/(1 + Ar)$ (A being a parameter of the potential). Some illustrative numerical results pertaining to the mercury atom are presented. (auth)